RECORD CO[illegible] Ek.

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving O[illegible] e only

PCT/FI 9 9 / 0 0 2 4 7

International Application No. 09/647081

International Filing Date 25 MAR 1999 (25. 03. 99)

The Finnish Patent Office
PCT International Application

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum) T298020PC/su

Box No. I TITLE OF INVENTION

Method of transmitting synchronized channel in radio transmitter

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

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This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

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☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

See Notes to the request form

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet is not to be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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- ☐ applicant only
- ☒ applicant and inventor
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State *(that is, country)* of nationality: FI

State *(that is, country)* of residence: FI

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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This person is:

- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: FI

State *(that is, country)* of residence: FI

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: IS

State *(that is, country)* of residence: FI

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

HYVÄRINEN, Olli ▲

This person is:

- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

▲ change see 8

State *(that is, country)* of nationality: FI ▲

State *(that is, country)* of residence: FI ▲

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No. V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked):*

Regional Patent

- ☒ **AP** **ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **SD** Sudan, **SZ** Swaziland, **UG** Uganda, **ZW** Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ **EA** **Eurasian Patent:** **AM** Armenia, **AZ** Azerbaijan, **BY** Belarus, **KG** Kyrgyzstan, **KZ** Kazakstan, **MD** Republic of Moldova, **RU** Russian Federation, **TJ** Tajikistan, **TM** Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ **EP** **European Patent:** **AT** Austria, **BE** Belgium, **CH and LI** Switzerland and Liechtenstein, **CY** Cyprus, **DE** Germany, **DK** Denmark, **ES** Spain, **FI** Finland, **FR** France, **GB** United Kingdom, **GR** Greece, **IE** Ireland, **IT** Italy, **LU** Luxembourg, **MC** Monaco, **NL** Netherlands, **PT** Portugal, **SE** Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ **OA** **OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Côte d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **GW** Guinea-Bissau, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)*

National patent *(if other kind of protection or treatment desired, specify on dotted line):*

- ☒ **AL** Albania
- ☒ **AM** Armenia
- ☒ **AT** Austria and utility model
- ☒ **AU** Australia
- ☒ **AZ** Azerbaijan
- ☒ **BA** Bosnia and Herzegovina
- ☒ **BB** Barbados
- ☒ **BG** Bulgaria
- ☒ **BR** Brazil
- ☒ **BY** Belarus
- ☒ **CA** Canada
- ☒ **CH and LI** Switzerland and Liechtenstein
- ☒ **CN** China
- ☒ **CU** Cuba
- ☒ **CZ** Czech Republic and utility model
- ☒ **DE** Germany and utility model
- ☒ **DK** Denmark and utility model
- ☒ **EE** Estonia and utility model
- ☒ **ES** Spain
- ☒ **FI** Finland and utility model
- ☒ **GB** United Kingdom
- ☒ **GD** Grenada
- ☒ **GE** Georgia
- ☒ **GH** Ghana
- ☒ **GM** Gambia
- ☒ **HR** Croatia
- ☒ **HU** Hungary
- ☒ **ID** Indonesia
- ☒ **IL** Israel
- ☒ **IN** India
- ☒ **IS** Iceland
- ☒ **JP** Japan
- ☒ **KE** Kenya
- ☒ **KG** Kyrgyzstan
- ☒ **KP** Democratic People's Republic of Korea
- ☒ **KR** Republic of Korea
- ☒ **KZ** Kazakstan
- ☒ **LC** Saint Lucia
- ☒ **LK** Sri Lanka
- ☒ **LR** Liberia
- ☒ **LS** Lesotho
- ☒ **LT** Lithuania
- ☒ **LU** Luxembourg
- ☒ **LV** Latvia
- ☒ **MD** Republic of Moldova
- ☒ **MG** Madagascar
- ☒ **MK** The former Yugoslav Republic of Macedonia
- ☒ **MN** Mongolia
- ☒ **MW** Malawi
- ☒ **MX** Mexico
- ☒ **NO** Norway
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- ☒ **SG** Singapore
- ☒ **SI** Slovenia
- ☒ **SK** Slovakia and utility model
- ☒ **SL** Sierra Leone
- ☒ **TJ** Tajikistan
- ☒ **TM** Turkmenistan
- ☒ **TR** Turkey
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- ☒ **US** United States of America
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- ☒ **YU** Yugoslavia
- ☒ **ZW** Zimbabwe

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

- ☒ **AE** United Arab Emirates
- ☒ **ZA** Republic of South Africa
- ☐

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box

	Filing Date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application:* regional Office	international application receiving Office
item (1)	27 March 1998 (27.03.1998)	980704	FI		
item (2)					
item (3)					

☒ The receiving Office is hereby requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s) : (1)

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(If two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):*
ISA /SE

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*
Date *(day/month/year)*: Number Country *(or regional Office)*

Box No. VIII CHECK LIST

This international application contains the following **number of sheets:**

request	:	4
description (excluding sequence listing part)	:	10
claims	:	4
abstract	:	1
drawings	:	5
sequence listing part of description	:	0
Total number of sheets	:	**24**

This international application is **accompanied by** the item(s) marked below

1. ☒ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☒ copy of general power of attorney
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language)
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other (specify):

Figure of the drawings which should accompany the abstract: 7

Language of filing of the international application: Finnish

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).

PATENTTITOIMISTO TEKNOPOLIS KOLSTER OY

Tapio Valkeiskangas

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1. Date of actual receipt of the purported international application:	25 MAR 1999 (25 -03- 1999)	2. Drawings: ☐ received ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:		
4. Date of timely receipt of the required corrections under PCT Article 11(2):		
5. International Searching Authority specified by the applicant: ISA/ SE	6. ☐ Transmittal of search copy delayed until search fee is paid	

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Date of receipt of the record copy by the International Bureau: 16 APRIL 1999 (16.04.99)

Menetelmä lähettää synkronoitu kanava radiolähettimessä

Keksinnön ala

Keksinnön kohteena on menetelmä lähettää synkronoitu kanava radiolähettimessä, jossa lähetetään normaalissa kanavassa normaalit radiopurskeet epäsynkronisesti.

Keksinnön tausta

Solukkoradioverkoissa on sovelluksia, jotka edellyttävät että tilaajapäätelaite, tai vastaava radiovastaanotin, vastaanottaa synkronoituja radiosignaaleja eri tukiasemilta. Tällaisia sovelluksia ovat esimerkiksi erilaiset tilaajapäätelaitteiden sijainnin paikantamismenetelmät. Eräs sellainen paikannusmenetelmä on havaitun ajoituseron (observed time difference, OTD) menetelmä, joka perustuu signaalien vastaanotossa havaittuihin aikaeroihin. Tässä menetelmässä päätelaite mittaa tukiasemien lähettämien signaalien saapumisaikaeroja. Menetelmää varten tukiasemien on lähetettävä signaaleja samalla hetkellä, eli synkronisesti, tai sitten tarvitaan tieto tukiasemien synkronointieroista (RTD, real time difference), mikäli tukiasemat eivät ole synkronissa. Paikannus tapahtuu näiden tietojen avulla. Tätä menetelmää on tarkemmin selostettu patenttihakemuksessa FI 954705.

Useat systeemit, kuten GSM-järjestelmä, eivät ole synkronoituja, tai sitten ne eivät ole tarpeeksi tarkasti synkronoituja, jotta signaaleja voitaisiin käyttää OTD-menetelmän mukaiseen paikantamiseen. GSM-järjestelmässä normaalit kanavat on jaettu sekä aikajakoisesti (TDMA, time division multiple access) että taajuusjakoisesti (FDMA, frequency division multiple access). Siten radiolähetin käyttää normaalin fyysisen kanavan lähettämiseen tietyn taajuuden tiettyä aikaväliä (time slot). GSM-järjestelmässä tukiasemat lähettävät normaalin kanavan radiopurskeet epäsynkronisesti, eli tukiasemien välisiä lähetyksiä ei koordinoida siten, että kukin tukiasema lähettäisi radiopurskeen samanaikaisesti. Lisäksi aiemmin mainitut tukiasemien väliset synkronointierot muuttuvat ajan kuluessa. Siten OTD-menetelmää ei voida käyttää paikannukseen ilman, että synkronointieroja mitataan koko ajan. Synkronointierojen mittaaminen generoi lisää signalointia sekä aiheuttaa ylimääräistä virhettä paikannuksen tarkkuuteen.

Eräs ehdotettu ratkaisu on synkronoida kaikki radiolähettimet keskenään käyttäen satelliittipohjaista paikannusjärjestelmää (global positioning system, GPS). Kuhunkin tukiasemaan installoitaisiin GPS-vastaanotin. GSM-

järjestelmässä tämä ratkaisu saattaa aiheuttaa ongelmia, koska järjestelmä käyttää hierarkkisia kelloja. Tämä tarkoittaa sitä, että tukiasemaa ohjaava tukiasemaohjain hankkii ajastuksen verkon ylemmiltä verkkoelementeiltä ja toimittaa sen tukiasemille. Jos GPS-vastaanotinta käytettäisiin tukiaseman lähetyksen ajastukseen, sekoitettaisiin tällöin koko GSM-järjestelmän laajuinen ajastus.

Keksinnön lyhyt selostus

Keksinnön tavoitteena on siten kehittää menetelmä ja menetelmän toteuttava laitteisto siten, että yllä mainitut ongelmat saadaan ratkaistua. Tämä saavutetaan johdannossa esitetyn tyyppisellä menetelmällä, jolle on tunnusomaista, että: saadaan synkronoitu ajastus; muodostetaan synkronoidut radiopurskeet, jonka synkronoidun radiopurskeen pituus on enintään puolet normaalin radiopurskeen pituudesta; lähetetään synkronoitu radiopurske normaalin radiopurskeen paikalla siten, että synkronoidun radiopurskeen lähetys on synkronissa saadun synkronoidun ajastuksen kanssa.

Keksinnön kohteena on lisäksi radiolähetin, käsittäen: kanavakoodekki muodostaa normaali kanava; purskemuodostin muodostaa normaalit radiopurskeet; multiplekseri osoittaa kullekin purskeelle sen lähetysajankohta.

Radiolähettimelle on keksinnön mukaisesti tunnusomaista, että: käsittää lisäksi kellon saada synkronoitu ajastus; kanavakoodekki on sovitettu muodostamaan synkronoitu kanava; purskemuodostin on sovitettu muodostamaan synkronoidut radiopurskeet, jonka synkronoidun radiopurskeen pituus on enintään puolet normaalin radiopurskeen pituudesta; multiplekseri on sovitettu sijoittamaan synkronoitu radiopurske normaalin radiopurskeen paikalle siten, että synkronoidun radiopurskeen lähetys on synkronissa saadun synkronoidun ajastuksen kanssa.

Keksinnön edulliset suoritusmuodot ovat epäitsenäisten patenttivaatimusten kohteena.

Keksintö perustuu siihen, että radiolähettimen normaalisti käyttämä radiopurske vähintään puolitetaan, jolloin aikaansaatu synkronoitu radiopurske voidaan aina liukuvasti sijoittaa normaalin radiopurskeen paikalle. Termillä "paikalla" tarkoitetaan sitä, että periaatteessa korvataan normaali radiopurske, eli ei siis välttämättä korvata todellisesti lähetettävää pursketta, vaan lähetetään synkronoitu purske sen aikavälin aikana, jona periaatteessa olisi mahdollista lähettää normaali radiopurske.

Keksinnön mukaisella menetelmällä ja radiolähettimellä saavutetaan useita etuja. Synkronoidut signaalit voidaan lähettää vastaanottajalle ilman, että yleiseen ajastusrakenteeseen tarvitsee tehdä muutoksia. Esimerkiksi GSM-järjestelmässä ei TDMA-kehysrakennetta tarvitse muuttaa. Synkronoitujen signaalien rakennetta voidaan optimoida käyttötarkoituksen, esimerkiksi paikannusmenetelmän, tarpeiden mukaan.

Kuvioiden lyhyt selostus

Keksintöä selostetaan nyt lähemmin edullisten suoritusmuotojen yhteydessä, viitaten oheisiin piirroksiin, joista:

Kuvio 1 esittää esimerkkiä keksintöä käyttävän solukkoradioverkon rakenteesta

Kuvio 2 esittää lähetinvastaanottimen rakennetta;

Kuvio 3 esittää keksinnön mukaisia synkronoituja radiopurskeita ja niiden lähetysajanhetkiä neljässä eri tukiasemassa;

Kuvio 4 esittää kahta eri vaihtoehtoa lähettää synkronoitu radiopurske normaalin radiopurskeen paikalla;

Kuvio 5 esittää synkronoidun radiopurskeen rakennetta;

Kuviot 6 ja 7 ovat vuokaavioita, jotka havainnollistavat keksinnön mukaisen menetelmän suoritusta;

Kuvio 8 esittää synkronoidun radiopurskeen sijoittamista täytebittien kanssa normaalin radiopurskeen paikalle.

Keksinnön yksityiskohtainen selostus

Keksintöä voidaan käyttää erilaisissa radiolähettimissä. Esimerkeissä kuvataan keksinnön käyttöä solukkoradioverkossa. Viitaten kuvioon 1 selostetaan tyypillinen solukkoradioverkon rakenne. Kuvio 1 sisältää vain keksinnön selittämisen kannalta oleelliset lohkot, mutta alan ammattimiehelle on selvää, että tavanomaiseen solukkoradioverkkoon sisältyy lisäksi muitakin toimintoja ja rakenteita, joiden tarkempi selittäminen ei tässä ole tarpeen. Esimerkeissä kuvataan TDMA:ta (Time Division Multiple Access) käyttävä solukkoradioverkko siihen kuitenkaan rajoittumatta.

Solukkoradioverkko käsittää tyypillisesti kiinteän verkon infrastruktuurin eli verkko-osan 128, ja tilaajapäätelaitteita 150, jotka voivat olla kiinteästi sijoitettuja, ajoneuvoon sijoitettuja tai kannettavia mukanapidettäviä päätelaitteita. Verkko-osassa 128 on tukiasemia 100. Useita tukiasemia 100 keskitetysti puolestaan ohjaa niihin yhteydessä oleva tukiasemaohjain 102. Tukiasemas-

sa 100 on lähetinvastaanottimia 114. Tyypillisesti tukiasemassa 100 on yhdestä kuuteentoista lähetinvastaanotinta 114. Esimerkiksi TDMA-radiojärjestelmässä yksi lähetinvastaanotin 114 tarjoaa tyypillisesti radiokapasiteetin yhdelle TDMA-kehykselle, siis kahdeksalle aikavälille.

Tukiasemassa 100 on ohjausyksikkö 118, joka ohjaa lähetinvastaanottimien 114 ja multiplekserin 116 toimintaa. Multiplekserillä 116 sijoitetaan useiden lähetinvastaanottimen 114 käyttämät liikenne- ja ohjauskanavat yhdelle siirtoyhteydelle 160.

Tukiaseman 100 lähetinvastaanottimista 114 on yhteys antenniyksikköön 112, jolla toteutetaan kaksisuuntainen radioyhteys 170 tilaajapäätelaitteeseen 150. Kaksisuuntaisessa radioyhteydessä 170 siirrettävien kehysten rakenne on tarkasti määritelty, ja sitä kutsutaan ilmarajapinnaksi.

Kuviossa 2 kuvataan tarkemmin yhden lähetinvastaanottimen 114 rakenne. Ensin kuvataan toiminnot vastaanotossa. Vastaanotin 200 käsittää suodattimen, joka estää halutun taajuuskaistan ulkopuoliset taajuudet. Sen jälkeen signaali muunnetaan välitaajuudelle tai suoraan kantataajuudelle, jossa muodossa oleva signaali näytteistetään ja kvantisoidaan analogia/digitaalimuuntimessa 202.

Ekvalisaattori 204 kompensoi häiriöitä, esimerkiksi monitie-etenemisen aiheuttamia häiriöitä. Demodulaattori 206 ottaa ekvalisoidusta signaalista bittivirran, joka välitetään demultiplekserille 208. Demultiplekseri 208 erottelee halutun osan vastaanotetusta bittivirrasta loogisiin kanaviin. Tämä toiminto perustuu vastaanotetun bittivirran rakenteeseen, joka muodostuu aikaväleihin sijoitetuista radiopurskeista, jotka muodostavat fyysisen kanavan.

Kanavakoodekki 216 dekoodaa eri loogisten kanavien bittivirran, eli päättää, onko bittivirta signalointitietoa, joka välitetään ohjausyksikölle 214, vai onko bittivirta puhetta, joka välitetään 240 tukiasemaohjaimen 102 puhekoodekille 122. Kanavakoodekki 216 purkaa mahdolliset kanavakoodaukset, esimerkiksi lohkokoodauksen ja konvoluutiokoodauksen, ja purkaa mahdollisen lomituksen, sekä purkaa radiotiellä käytetyn salauksen.

Ohjausyksikkö 214 suorittaa sisäisiä kontrollitehtäviä ohjaamalla eri yksikköjä, pääasiassa tukiasemaohjaimelta 102 saamansa ohjauksen mukaisesti.

Sitten kuvataan toiminnot lähetyksessä. Lähetettävä data kanavakoodataan, lomitetaan ja salataan kanavakoodekissa 216. Purskemuodostin 228 lisää opetussekvenssin ja hännän kanavakoodekista 216 tulevaan dataan. Multiplekseri 226 osoittaa kullekin purskeelle sen fyysisen kanavan. Modu-

laattori 224 moduloi digitaaliset signaalit radiotaajuiselle kantoaallolle. Tämä toiminto on analoginen luonteeltaan, joten sen suorittamisesta tarvitaan digitaali/analogia-muunninta 222.

Lähetin 220 käsittää suodattimen, jolla kaistanleveyttä rajoitetaan. Lisäksi lähetin 220 kontrolloi lähetyksen ulostulotehoa. Syntetisaattori 212 järjestää tarvittavat taajuudet eri yksiköille. Syntetisaattorin 212 sisältämä kello voi olla paikallisesti ohjattu tai sitä voidaan ohjata keskitetysti jostain muualta, esimerkiksi tukiasemaohjaimesta 102. Syntetisaattori 212 luo tarvitut taajuudet esimerkiksi jänniteohjatulla oskillaattorilla.

Kuviossa 2 esitettävällä tavalla voidaan lähetinvastaanottimen rakenne jakaa vielä radiotaajuusosiin 230 ja digitaaliseen signaalinkäsittelyprosessoriin ohjelmistoineen 232. Radiotaajuusosiin 230 kuuluvat vastaanotin 200, lähetin 220 ja syntetisaattori 212. Digitaaliseen signaalinkäsittelyprosessoriin ohjelmistoineen 232 kuuluvat ekvalisaattori 204, demodulaattori 206, demultiplekseri 208, kanavakoodekki 216, ohjausyksikkö 214, purskemuodostin 228, multiplekseri 226 ja modulaattori 224. Analogisen radiosignaalin muuntamiseksi digitaaliseksi signaaliksi tarvitaan analogia/digitaalimuunnin 202, ja vastaavasti digitaalisen signaalin muuntamiseksi analogiseksi signaaliksi digitaali/-analogia-muunnin 222.

Tukiasemaohjain 102 käsittää ryhmäkytkentäkentän 120 ja ohjausyksikön 124. Ryhmäkytkentäkenttää 120 käytetään puheen ja datan kytkentään sekä yhdistämään signalointipiirejä. Tukiaseman 100 ja tukiasemaohjaimen 102 muodostamaan tukiasemajärjestelmään (Base Station System) 126 kuuluu lisäksi transkooderi 122. Tukiasemaohjaimen 102 ja tukiaseman 100 välinen työnjako ja fyysinen rakenne voi vaihdella toteutuksesta riippuen. Tyypillisesti tukiasema 100 huolehtii edellä kuvatulla tavalla radiotien toteutuksesta. Tukiasemaohjain 102 hallinnoi tyypillisesti seuraavia asioita: liikennekanavien konfigurointi, taajuushyppelykontrolli, tilaajapäätelaitteen kutsuminen (paging), tehonsäätö, aktiivisten kanavien laadunvalvonta, ja kanavanvaihdon (handover) kontrolli.

Transkooderi 122 sijaitsee yleensä mahdollisimman lähellä matkapuhelinkeskusta 132, koska puhe voidaan tällöin siirtokapasiteettia säästäen siirtää solukkoradioverkon muodossa transkooderin 122 ja tukiasemaohjaimen 102 välillä. Transkooderi 122 muuntaa yleisen puhelinverkon ja radiopuhelinverkon välillä käytettävät erilaiset puheen digitaaliset koodausmuodot toisilleen sopiviksi, esimerkiksi kiinteän verkon 64 kbit/s muodosta solukkoradioverkon johonkin muuhun (esimerkiksi 13 kbit/s) muotoon ja päinvastoin. Ohjausyksik-

kö 124 suorittaa puhelunohjausta, liikkuvuuden hallintaa, tilastotietojen keräystä ja signalointia.

Kuvion 1 mukaisesti voidaan tilaajapäätelaitteesta 150 muodostaa piirikytkentäinen yhteys yleiseen puhelinverkkoon (PSTN = Public Switched Telephone Network) 134 kytkettyyn puhelimeen 136 matkapuhelinkeskuksen 132 välityksellä. Solukkoradioverkossa voidaan käyttää myös pakettikytkentäistä yhteyttä, esimerkiksi GSM-järjestelmän 2+-vaiheen pakettisiirtoa eli GPRS:a (General Packet Radio Service).

Tilaajapäätelaitteen 150 rakenne voidaan kuvata kuvion 2 lähetinvastaanottimen 114 rakenteen kuvausta hyödyntäen. Tilaajapäätelaitteen 150 rakenneosat ovat toiminnollisesti samat kuin lähetinvastaanottimen 114. Lisäksi tilaajapäätelaitteessa 150 on duplex-suodatin antennin 112 ja vastaanottimen 200 sekä lähettimen 220 välissä, käyttöliittymäosat ja puhekoodekki. Puhekoodekki liittyy väylän 240 välityksellä kanavakoodekkiin 216.

Kuviossa 3 kuvataan kuinka neljän eri tukiaseman BTS 1, BTS 2, BTS 3, BTS 4 lähetykset eivät ole synkronissa keskenään. Kukin tukiasema lähettää normaalit purskeensa NB toisistaan satunnaisesti poikkeavilla ajanhetkillä. Keksinnön mukaisesti kukin tukiasema saa ajastuksen, jota kuviossa 3 kuvataan toisiaan seuraavilla purskeilla SYNCHRONIZED BURSTS. Ajastus saadaan kellosta, joka on esimerkiksi kuviossa 1 kuvatulla tavalla tukiaseman 100 ohjausyksikköön 118 liitetty GPS-vastaanotin 180. Ohjausyksikkö 118 välittää sitten saadun ajan lähetinvastaanottimille 114.

Keksinnön mukaisesti muodostetaan erityinen synkroninen kanava kanavakoodekissa 216. Periaatteessa synkroninen kanava sijoitetaan jollekin normaalille fyysiselle kanavalle. Käytettävien fyysisten kanavien lukumäärä on kompromissi. Esimerkiksi OTD-paikannusmenetelmässä mitä useammin lähetetään synkronisia signaaleja, sitä useammin tilaajapäätelaitteella 150 on mahdollisuus vastaanottaa niitä, ja siten tehdä enemmän mittauksia, joka parantaa paikantamisen tarkkuutta. Toisaalta näin kulutetaan enemmän järjestelmän liikennekapasiteettia. Kuvion 3 esimerkissä käytetään yhtä taajuutta, eli yhden TDMA-kehyksen kaikkia kahdeksaa aikaväliä, eli kahdeksaa fyysistä liikennekanavaa. Haluttaessa minimoida liikennekapasiteetin haaskaus voidaan käyttää vain yhtä aikaväliä synkronoitujen purskeiden lähettämiseen, esimerkiksi BCCH-taajuuden (Broadcast Control Channel) aikaväliä yksi, jolloin tilaajapäätelaite 150 aina tietää synkronoitujen purskeiden sijainnin vastaanotettuaan yhden normaalin SCH-purskeen (Synchronization Channel Burst). Jottei laske-

van siirtotien synkronoitua kanavaa vastaavan nousevan siirtotien fyysisen kanavan kapasiteetti menisi hukkaan, voidaan sitä käyttää signalointitiedon, kuten tilaajapäätelaitteen 150 mittaustulosten kuljettamiseen tukiasemalle 100.

Eräässä edullisessa toteutusmuodossa hyödynnetään normaalisti käyttämättömänä olevaa kapasiteettia synkronoitujen radiopurskeiden lähettämiseen. Esimerkiksi radiolähettimen ollessa epäjatkuvassa lähetystilassa (discontinuous transmission, DTX), voidaan normaalien radiopurskeiden lähetyksen ollessa keskeytynyt lähettää niiden tilalla synkronoituja radiopurskeita, joiden perusteella tilaajapäätelaite 150 voi esimerkiksi suorittaa sijaintinsa paikantamisen.

Toinen tapa tehostaa toimintaa on lähettää synkronoituja radiopurskeita käyttäen vain osaa fyysisen kanavan kapasiteetista. Tällöin synkroniset purskeet toistuvat jonkin ennalta määrätyn sekvenssin mukaisesti, esimerkiksi fyysisen kanavan joka kolmannessa aikavälissä.

Tilaajapäätelaitteelle 150 voidaan kertoa synkronoidun kanavan lähettämiseen käytettävä fyysinen kanava jollakin ohjauskanavalla, esimerkiksi BCCH-kanavalla (Broadcast Control Channel).

Purskemuodostin 228 on sovitettu muodostamaan synkronoidut radiopurskeet SB. Synkronoidun radiopurskeen SB pituus on enintään puolet normaalisti käytettävän purskeen NB pituudesta, koska siten synkronoitu radiopurske SB saadaan aina sijoitettua normaalin purskeen NB paikalle. Multiplekseri 226 on sovitettu sijoittamaan synkronoitu radiopurske SB normaalin radiopurskeen NB paikalle, siten että synkronoidun radiopurskeen SB lähetys on synkronissa kellosta 180 saadun ajastuksen kanssa.

Kuviossa 3 kuvataan siis ajastusta mahdollisina synkronoituina purskeina SYNCHRONIZED BURSTS, ja kunkin tällaisen purskeen alku- ja loppuhetkestä on piirretty vertikaalinen viiva, joka kuvaa kussakin tukiasemassa BTS 1 TIMING, BTS 2 TIMING, BTS 3 TIMING, BTS 4 TIMING mahdollisen synkronisen purskeen SB lähetyshetken. Kunkin tukiaseman lähettämät synkronoidut purskeet SB alkavat ja päättyvät täsmälleen samalla ajanhetkellä.

Kuten kuviota 3 tarkastelemalla voidaan todeta, niin eräässä edullisessa toteutusmuodossa tukiaseman BTS 1 kohdalla ajastukset ovat sattumalta samat, ja normaalipurskeen NB paikalla pystytään lähettämään kaksi synkronoitua pursketta SB. Tällöin purskemuodostin 228 on sovitettu muodostamaan peräkkäiset synkronoidut purskeet SB, ja multiplekseri 226 sijoittaa ne molemmat normaalipurskeen NB paikalle, koska ne mahtuvat siihen. Toisaalta

tästä toteutusmuodosta voidaan myös pidättäytyä, mikäli kahden synkronoidun purskeen vastaanottaminen yhden aikavälin aikana aiheuttaisi ongelmia tilaajapäätelaitteelle 150, jolloin lähetetään vain toinen synkronoiduista purskeista.

Tukiaseman BTS 2 kohdalla ajastukset poikkeavat toisistaan täsmälleen puoli aikaväliä, ja siten pystytään myös normaalipurskeen NB paikalla lähettämään kaksi synkronoitua pursketta SB.

Tavallisin tilanne on kuitenkin se, että tukiaseman 100 verkosta saama ajastus ja kellosta 180 saama ajastus eivät sattumalta ole yhdenmukaiset. Tällöin kuviossa 3 tukiasemien BTS 3 ja BTS 4 tavoin pystytään normaalipurskeen NB paikalla lähettämään vain yksi synkronoitu purske SB. Sillä kuten kuviosta nähdään, joka toinen synkroninen purske SB ulottuisi kahteen normaalipurskeeseen NB, mikä ei ole toivottavaa.

Kuviossa 5 havainnollistetaan synkronoidun purskeen SB rakennetta. Kuten normaalissakin purskeessa on synkronoidussa purskeessa oltava häntäbittejä TB sekä purskeen alussa että lopussa. Näitä bittejä käytetään suoja-aikana, jonka kuluessa lähetin suorittaa tehonnoston vaadittavaan lähetystehoon, ja jälleen tehonlaskun lepotilaan. Normaalisti häntäbitit asetetaan nolliksi.

Kuvion 4 mukaisesti synkronoitu purske SB voidaan sijoittaa normaalin purskeen NB paikalle kahdella eri tavalla. Ensimmäinen tapa on kuvattu kuviossa keskimmäisenä. Siinä synkronoitu purske SB on kuvion 5 mukainen erikoispurske, jonka pituus on enintään puolet normaalista purskeesta NB. Kyseisessä aikavälissä ei siis lähetetä mitään muuta synkronoidun purskeen SB lisäksi.

Toinen tapa on kuvattu kuviossa 4 alimmaisena vaihtoehtona. Siinä purskemuodostin 228 on sovitettu muodostamaan normaalin radiopurskeen NB mittainen purske, johon on sijoitettu synkronoitu purske SB. Se osa muodostetusta purskeesta, joka ei kuulu synkronoituun purskeeseen SB täytetään etukäteen määritellyillä täytebiteillä PAD. Tällä toteutusmuodolla saavutetaan se etu, ettei purskeen lähetysaikaa tarvitse muuttaa, vaan ainoastaan muutetaan purskeen sisältöä.

Kuvion 5 mukaisesti synkronoitu purske SB sisältää ainakin ennalta tunnetun bittikuvion TS. Yleensä tämä bittikuvio on opetussekvenssi, jonka vastaanotin myös tuntee, ja jota voidaan ekvalisaattorissa 204 hakea. Vertaamalla tätä tunnettua opetussekvenssiä ja todellisuudessa vastaanotettua sig-

naalia voidaan arvioida minkälaisia vääristymiä radiotiellä on signaaliin kertynyt. Vastaanotin saa myös tarkan ajastuksen vastaanottaessaan synkronoidun purskeen SB, koska sen lähetyshetki on täsmällisesti määrätty eri tukiasemien kesken samaksi, toisin kuin normaaleilla purskeilla NB. Paikantamismenetelmiä varten tunnetun bittikuvion rakennetta voidaan optimoida tarkoituksenmukaisella tavalla.

Eräässä edullisessa toteutusmuodossa synkronoituun purskeeseen sijoitetaan myös muuta informaatiota INFO kuvion 5 mukaisesti. Informaatio voi sisältää tukiaseman 100 sijaintikoordinaatit COORD. Myös ajastuksen offset OFFSET voidaan lähettää informaatiokentässä INFO, offsetilla tarkoitetaan tässä ideaalisen synkronoidun radiopurskeen lähetyshetken ja todellisen synkronisen radiopurskeen lähetyshetken välistä aikaeroa. Todellisuudessa synkronoidun purskeen SB lähetyshetkeä voidaan säätää vain ehkä yhden bitin tai yhden neljäsosa bitin tarkkuudella, jolloin offsetilla kerrotaan ero siihen mikä olisi ollut täsmälleen oikea lähetyshetki. Informaatio voi käsittää muutakin informaatiota OTHER INFO, ja informaatiota voidaan myös yhdistellä COORD + OFFSET halutulla tavalla.

Mikäli ajastuksesta halutaan mahdollisimman tarkka, tulisi opetussekvenssin TS olla mahdollisimman pitkä. Tällöin osa informaatiosta INFO, tai jopa kaikki informaatio INFO, voidaan siirtää täytebitteihin PAD, jolloin opetussekvenssiä TS voidaan jatkaa informaation INFO tilalle. Koska synkronoidun purskeen paikka SB vaihtelee, niin joskus informaatio INFO olisi ennen synkronoitua pursketta SB ja joskus se jälkeen. Tilaajapäätelaitteen 150 täytyy tällöin kyetä valitsemaan oikea kohta josta informaatio INFO dekoodataan.

Kuviossa 8 kuvataan miten synkronoitu radiopurske SB sijoitetaan täytebittien PAD kanssa normaalin radiopurskeen NB paikalle. Tämä kuvio selventää kuviossa 4 kuvatun alimmaisen vaihtoehdon toteuttamista. Häntäbitit TB ovat tietenkin purskeen alussa ja lopussa. Sitten tulevat täytebitit PAD, joiden ympäröiminä ovat opetussekvenssi TS ja informaatio INFO.

Edullisesti keksintö toteutetaan ohjelmallisesti, jolloin keksintö vaatii ohjelmistomuutoksia tarkasti rajatulle alueelle tukiaseman 100 lähetinvastaanottimen 114 digitaalisen signaalinkäsittelyprosessorin 232 ohjelmistoon. Lisäksi keksintö edellyttää, että radiolähetin saa synkronoidun ajastuksen, esimerkiksi kellosta 180.

Keksinnön mukaisen menetelmän suoritusta radiolähettimessä havainnollistetaan vielä viitaten kuvioissa 6 ja 7 esitettyihin vuokaavioihin. Mene-

telmä käynnistyy lohkossa 600. Lohkossa 602 mennään seuraavaan aikaväliin. Lohkossa 604 tarkistetaan onko kyseisessä aikavälissä lähetettävä looginen kanava normaali vai synkronoitu. Lohkossa 606 lähetetään normaalissa kanavassa normaalit radiopurskeet epäsynkronisesti. Lohkossa 608 lähetetään keksinnön mukaan muodostettu synkronoitu purske. Lohkossa 610 tarkistetaan jatketaanko menetelmän suorittamista. Ellei suorittamista jatketa, niin lohkossa 612 lopetetaan menetelmän suorittaminen. Mikäli suorittamista jatketaan, niin mennään lohkoon 602, jossa otetaan käsittelyyn seuraava aikaväli.

Lohkoa 608 kuvataan tarkemmin kuviossa 7. Suoritus alkaa lohkosta 700. Lohkossa 702 saadaan synkronoitu ajastus. Seuraavaksi tarkistetaan lohkossa 704, onko nyt aika lähettää synkronoitu purske. Ellei ole, niin mennään lohkoon 702, jossa tarkistetaan kello. Tätä toistetaan, kunnes on aika lähettää synkronoitu purske. Kun lohkossa 704 suoritetun tarkistuksen tuloksena havaitaan, että nyt on aika lähettää synkronoitu purske, mennään lohkoon 706. Lohkossa 706 tarkistetaan onko aikavälistä tarpeeksi jäljellä, jotta synkronoitu purske ehditään lähettää. Ellei aikaväliä ole tarpeeksi jäljellä, mennään lohkoon 712. Mikäli aikaväliä on tarpeeksi jäljellä, mennään lohkoon 708, jossa muodostetaan synkronoidut radiopurskeet SB, jonka synkronoidun radiopurskeen pituus on enintään puolet normaalin radiopurskeen pituudesta. Seuraavaksi lohkossa 710 lähetetään synkronoitu radiopurske normaalin radiopurskeen paikalla siten, että synkronoidun radiopurskeen lähetys on synkronissa saadun synkronoidun ajastuksen kanssa. Lopuksi mennään lohkoon 712, jossa päätetään lohkon 608 suorittaminen.

Vaikka keksintöä on edellä selostettu viitaten oheisten piirustusten mukaiseen esimerkkiin, on selvää, ettei keksintö ole rajoittunut siihen, vaan sitä voidaan muunnella monin tavoin oheisten patenttivaatimusten esittämän keksinnöllisen ajatuksen puitteissa.

Patenttivaatimukset

1. Menetelmä lähettää synkronoitu kanava radiolähettimessä, jossa (606) lähetetään normaalissa kanavassa normaalit radiopurskeet epäsynkronisesti, t u n n e t t u siitä, että:

(702) saadaan synkronoitu ajastus;

(708) muodostetaan synkronoidut radiopurskeet (SB), jonka synkronoidun radiopurskeen pituus on enintään puolet normaalin radiopurskeen pituudesta;

(710) lähetetään synkronoitu radiopurske normaalin radiopurskeen paikalla siten, että synkronoidun radiopurskeen lähetys on synkronissa saadun synkronoidun ajastuksen kanssa.

2. Patenttivaatimuksen 1 mukainen menetelmä, t u n n e t t u siitä, että luodaan ainakin kaksi peräkkäistä synkronista radiopursketta (SB), joista ainakin yksi lähetetään.

3. Patenttivaatimuksen 1 mukainen menetelmä, t u n n e t t u siitä, että sijoitetaan ainakin yksi synkronoitu radiopurske (SB) normaalin radiopurskeen mittaiseen purskeeseen.

4. Patenttivaatimuksen 3 mukainen menetelmä, t u n n e t t u siitä, että synkronoituun radiopurskeeseen (SB) kuulumaton osa purskeesta muodostuu etukäteen määritellyistä täytebiteistä (PAD).

5. Patenttivaatimuksen 1 mukainen menetelmä, t u n n e t t u siitä, että synkronoitu radiopurske (SB) sisältää ennalta tunnetun bittikuvion (TS).

6. Patenttivaatimuksen 5 mukainen menetelmä, t u n n e t t u siitä, että bittikuvio on opetussekvenssi.

7. Patenttivaatimuksen 1 mukainen menetelmä, t u n n e t t u siitä, että synkronoitu radiopurske (SB) sisältää informaatiota (INFO), kuten radiolähettimen sijaintikoordinaatit (COORD) ja/tai offsetin (OFFSET), eli ideaalisen synkronoidun radiopurskeen lähetyshetken ja todellisen synkronisen radiopurskeen lähetyshetken välisen aikaeron.

8. Patenttivaatimuksen 1 mukainen menetelmä, t u n n e t t u siitä, että sijoitetaan radiopurske aikaväliin.

9. Patenttivaatimuksen 1 mukainen menetelmä, t u n n e t t u siitä, että synkronoidun kanavan lähettämiseen käytetään ainakin yhtä normaalia fyysistä kanavaa.

10. Patenttivaatimuksen 9 mukainen menetelmä, t u n n e t t u siitä, että ilmoitetaan ohjauskanavalla synkronoidun kanavan lähettämiseen käytettävät fyysiset kanavat.

11. Patenttivaatimuksen 1 mukainen menetelmä, t u n n e t t u siitä, että lähetyssuunnan synkronisia kanavia vastaavia vastaanottosuunnan fyysisiä kanavia käytetään signalointitiedon kuten mittaustulosten kuljettamiseen.

12. Patenttivaatimuksen 1 mukainen menetelmä, t u n n e t t u siitä, että menetelmää käytetään paikannusmenetelmässä kuten havaitun ajoituseron menetelmässä.

13. Patenttivaatimuksen 1 mukainen menetelmä, t u n n e t t u siitä, että synkronoitu radiopurske lähetetään radiolähettimen ollessa epäjatkuvassa lähetystilassa.

14. Patenttivaatimuksen 1 mukainen menetelmä, t u n n e t t u siitä, että synkronoitujen radiopurskeiden lähettämiseen käytetään vain osa normaalin kanavan kapasiteetista.

15. Radiolähetin, käsittäen:

kanavakoodekki (216) muodostaa normaali kanava;

purskemuodostin (228) muodostaa normaalit radiopurskeet;

multiplekseri (226) osoittaa kullekin purskeelle sen lähetysajankohta;

t u n n e t t u siitä, että:

käsittää lisäksi kellon (180) saada synkronoitu ajastus;

kanavakoodekki (216) on sovitettu muodostamaan synkronoitu kanava;

purskemuodostin (228) on sovitettu muodostamaan synkronoidut radiopurskeet (SB), jonka synkronoidun radiopurskeen pituus on enintään puolet normaalin radiopurskeen pituudesta;

multiplekseri (226) on sovitettu sijoittamaan synkronoitu radiopurske normaalin radiopurskeen paikalle siten, että synkronoidun radiopurskeen lähetys on synkronissa saadun synkronoidun ajastuksen kanssa.

16. Patenttivaatimuksen 15 mukainen radiolähetin, t u n n e t t u siitä, että purskemuodostin (228) on sovitettu luomaan ainakin kaksi peräkkäistä synkronista radiopursketta (SB), ja multiplekseri (226) on sovitettu sijoittamaan niistä ainakin yksi normaalin radiopurskeen paikalle.

17. Patenttivaatimuksen 15 mukainen radiolähetin, t u n n e t t u siitä, että purskemuodostin (228) on sovitettu muodostamaan normaalin radio-

purskeen mittainen purske, johon on sijoitettu ainakin yksi synkronoitu radiopurske (SB).

18. Patenttivaatimuksen 17 mukainen radiolähetin, t u n n e t t u siitä, että purskemuodostin (228) on sovitettu sijoittamaan purskeen synkronoituun radiopurskeeseen (SB) kuulumattomaan osaan etukäteen määritellyt täytebitit (PAD).

19. Patenttivaatimuksen 15 mukainen radiolähetin, t u n n e t t u siitä, että purskemuodostin (228) on sovitettu sijoittamaan synkronoituun radiopurskeeseen (SB) ennalta tunnetun bittikuvion (TS).

20. Patenttivaatimuksen 19 mukainen radiolähetin, t u n n e t t u siitä, että bittikuvio on opetussekvenssi.

21. Patenttivaatimuksen 15 mukainen radiolähetin, t u n n e t t u siitä, että kanavakoodekki (216) on sovitettu sijoittamaan synkronoituun radiopurskeeseen (SB) informaatiota, kuten radiolähettimen sijaintikoordinaatit (COORD) ja/tai offsetin (OFFSET), eli ideaalisen synkronoidun radiopurskeen lähetyshetken ja todellisen synkronisen radiopurskeen lähetyshetken välisen aikaeron.

22. Patenttivaatimuksen 15 mukainen radiolähetin, t u n n e t t u siitä, että multiplekseri (226) on sovitettu sijoittamaan radiopurske aikaväliin.

23. Patenttivaatimuksen 15 mukainen radiolähetin, t u n n e t t u siitä, että kanavakoodekki (216) on sovitettu käyttämään synkronoidulle kanavalle ainakin yhtä normaalia fyysistä kanavaa.

24. Patenttivaatimuksen 23 mukainen radiolähetin, t u n n e t t u siitä, että radiolähetin on sovitettu ilmoittamaan ohjauskanavalla synkronoidun kanavan lähettämiseen käytettävät fyysiset kanavat.

25. Patenttivaatimuksen 15 mukainen radiolähetin, t u n n e t t u siitä, että radiolähetin on sovitettu vastaanottamaan lähetyssuunnan synkronisia kanavia vastaavilta vastaanottosuunnan kanavilta signalointitietoa kuten mittaustuloksia.

26. Patenttivaatimuksen 15 mukainen radiolähetin, t u n n e t t u siitä, että kello (180) on GPS-vastaanotin.

27. Patenttivaatimuksen 15 mukainen radiolähetin, t u n n e t t u siitä, että radiolähetin on sovitettu lähettämään synkronoitu radiopurske radiolähettimen ollessa epäjatkuvassa lähetystilassa.

28. Patenttivaatimuksen 15 mukainen radiolähetin, t u n n e t t u siitä, että radiolähetin on sovitettu käyttämään synkronoitujen radiopurskeiden lähettämiseen vain osa normaalin kanavan kapasiteetista.

(57) Tiivistelmä

Keksinnön kohteena on menetelmä lähettää synkronoitu kanava radiolähettimessä ja radiolähetin. Menetelmässä (606) lähetetään normaalissa kanavassa normaalit radiopurskeet epäsynkronisesti. Keksinnön mukaisesti (702) saadaan synkronoitu ajastus, (708) muodostetaan synkronoidut radiopurskeet (SB), ja (710) lähetetään synkronoitu radiopurske normaalin radiopurskeen (NB) paikalla. Synkronoidun radiopurskeen (SB) pituus on enintään puolet normaalin radiopurskeen (NB) pituudesta. Synkronoidun radiopurskeen (SB) lähetys on synkronissa saadun synkronoidun ajastuksen kanssa.

(Kuvio 7)

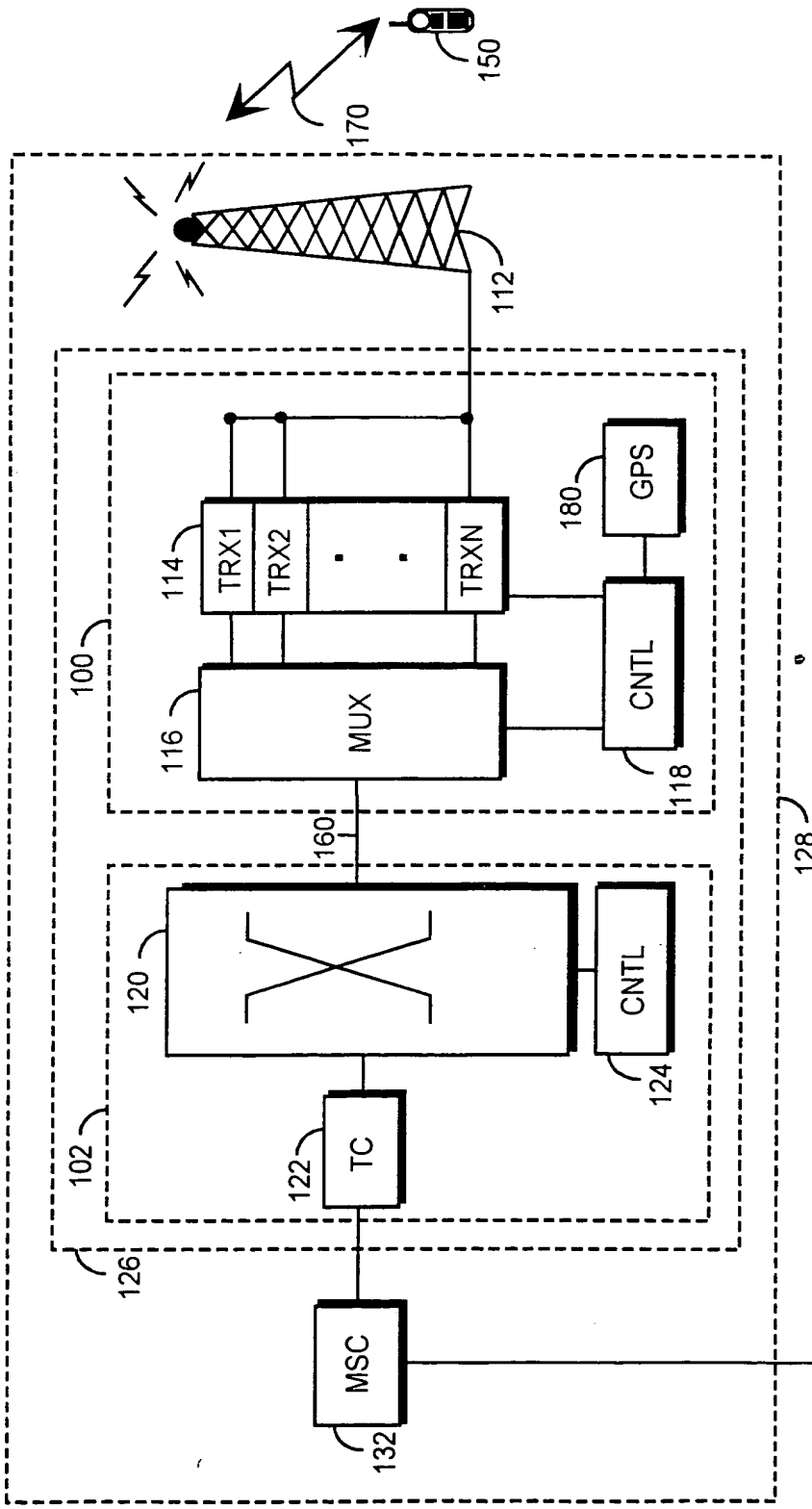
150
170
112
180
GPS
114
TRX1
TRX2
TRXN
CNTL
100
116
MUX
118
160
128
120
CNTL
124
102
122
TC
126
136
MSC
132
PSTN
134

Fig 1

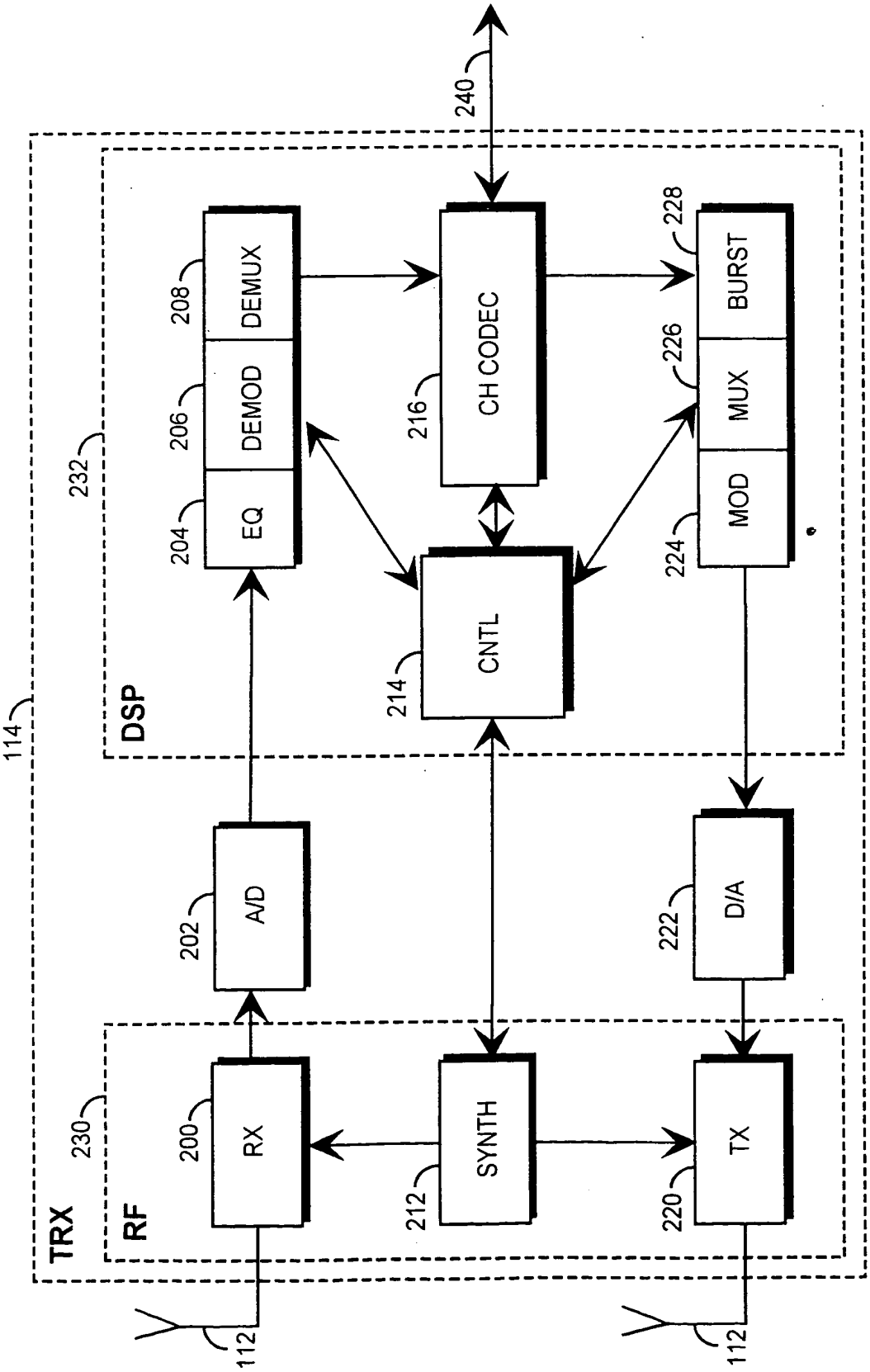
240
114
DSP
232
208
DEMUX
206
DEMOD
204
EQ
216
CH CODEC
228
BURST
226
MUX
224
MOD
214
CNTL
202
A/D
222
D/A
TRX
230
RF
200
RX
212
SYNTH
220
TX
112
112

Fig 2

Fig 3

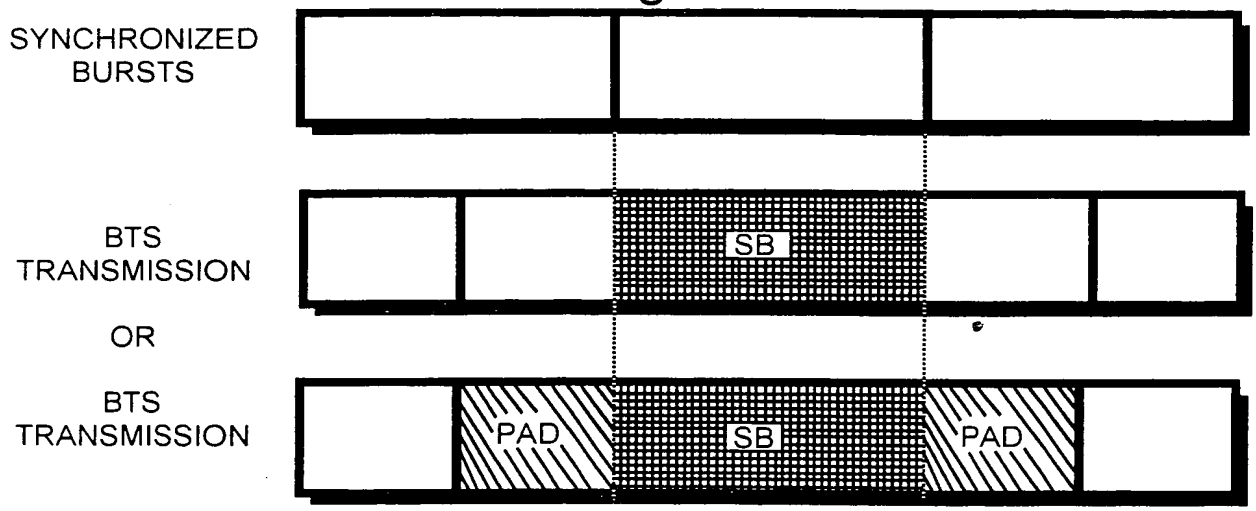

Fig 4

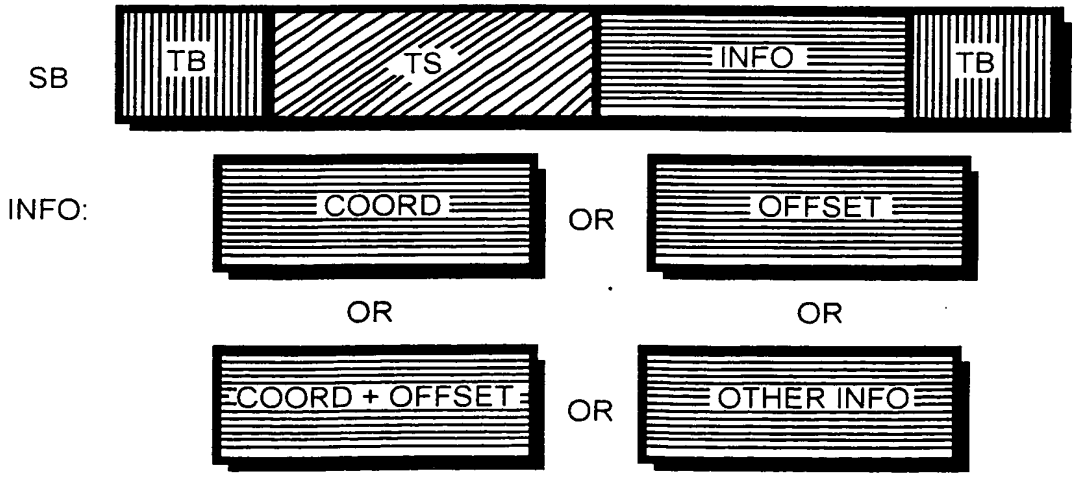

Fig 5

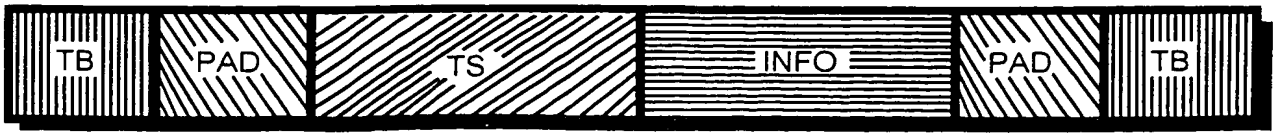

Fig 8

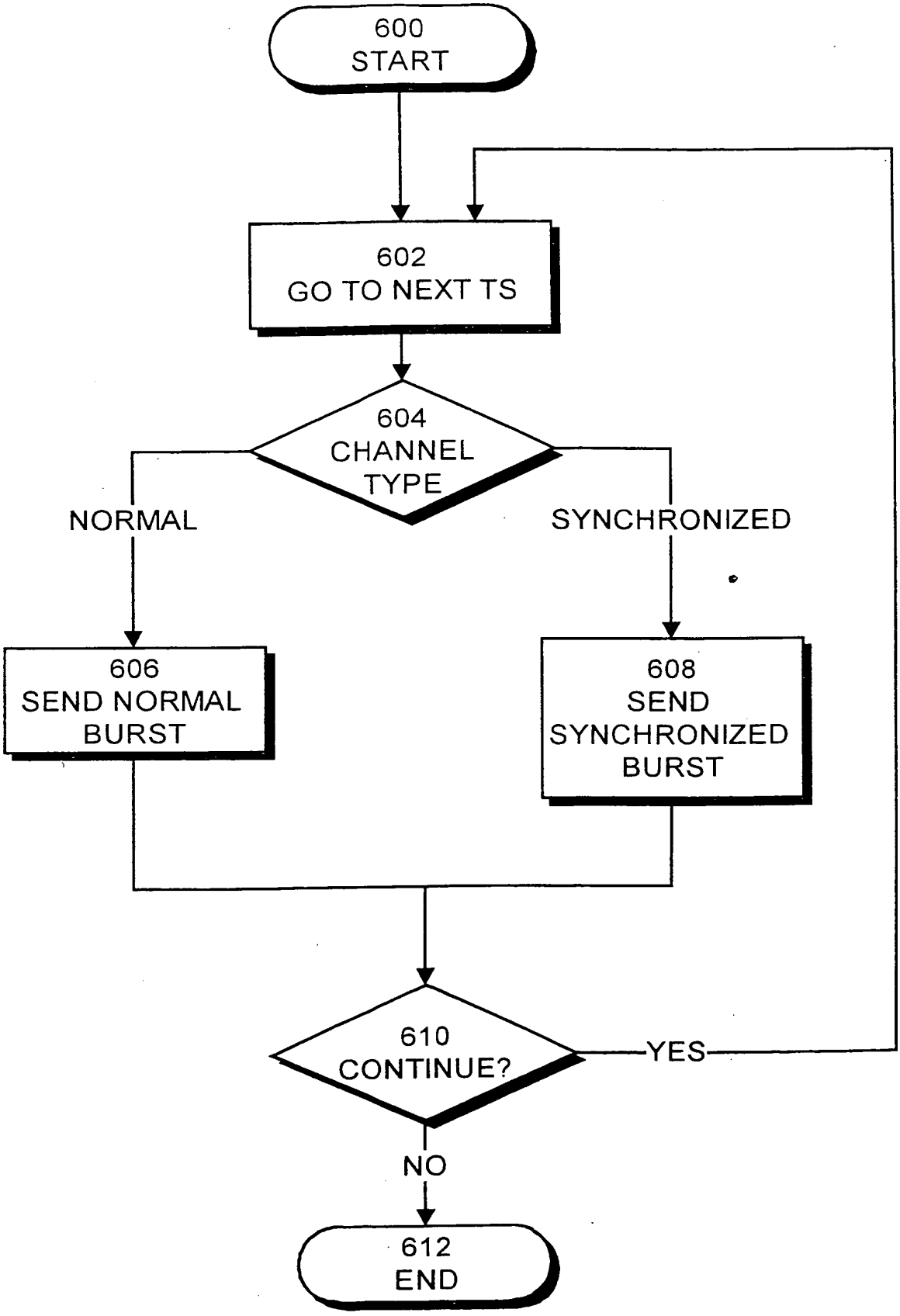
600
START
602
GO TO NEXT TS
604
CHANNEL
TYPE
NORMAL
SYNCHRONIZED
606
SEND NORMAL
BURST
608
SEND
SYNCHRONIZED
BURST
610
CONTINUE?
YES
NO
612
END

Fig 6

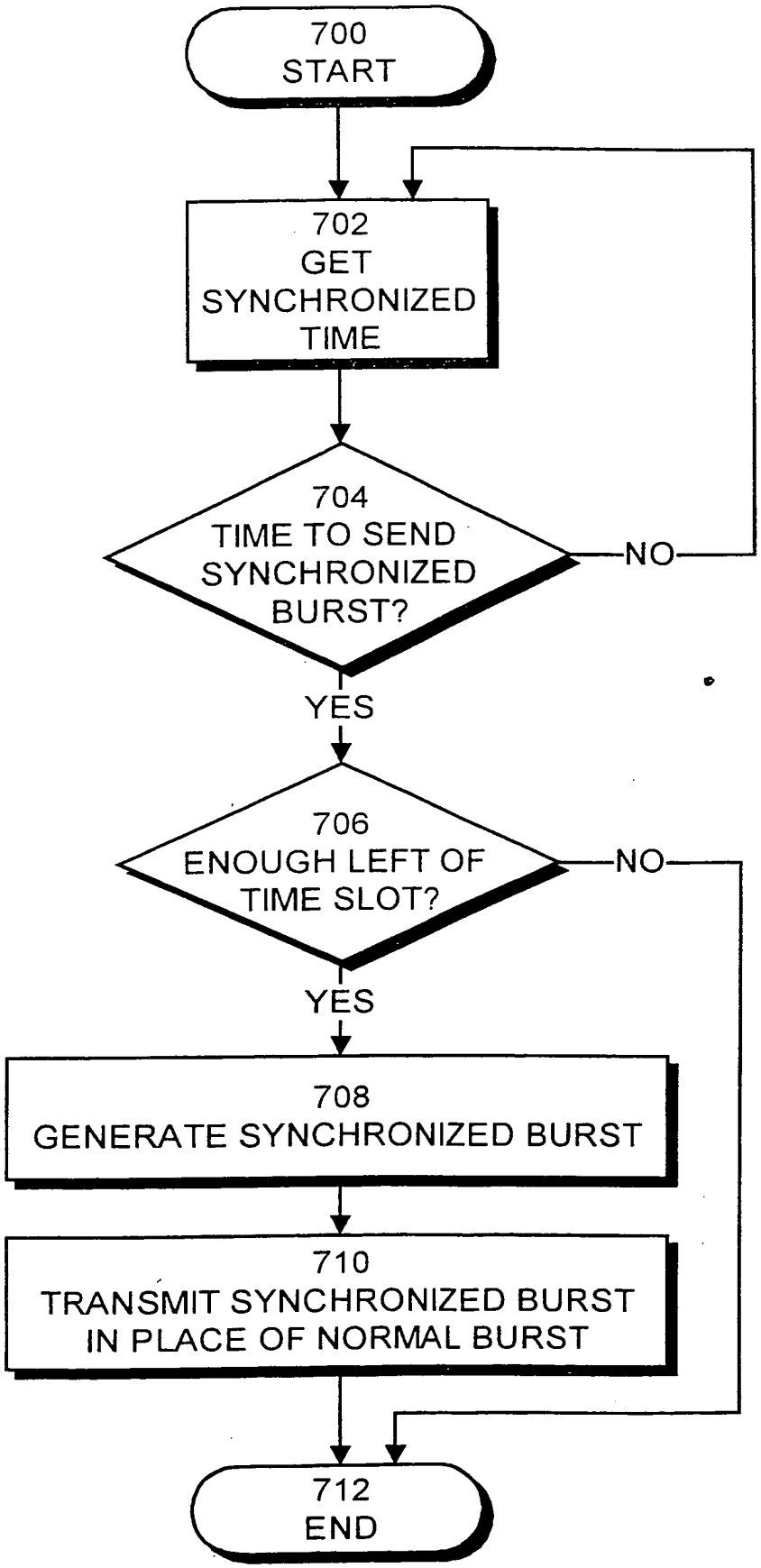
700
START
702
GET
SYNCHRONIZED
TIME
704
TIME TO SEND
SYNCHRONIZED
BURST?
NO
YES
706
ENOUGH LEFT OF
TIME SLOT?
NO
YES
708
GENERATE SYNCHRONIZED BURST
710
TRANSMIT SYNCHRONIZED BURST
IN PLACE OF NORMAL BURST
712
END

Fig 7

PATENT COOPERATION TREATY

09/647081

-2-11-2000

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

PATENTTITOIMISTO TEKNOPOLIS
KOLSTER OY
c/o Kolster OY AB
Iso Roobertinkatu 23
P.O. Box 148
FIN-00121 Helsinki
FINLANDE

Date of mailing (day/month/year)
28 October 1999 (28.10.99)

Applicant's or agent's file reference
T298020PC/su

IMPORTANT NOTIFICATION

International application No.
PCT/FI99/00247

International filing date (day/month/year)
25 March 1999 (25.03.99)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address
NOKIA TELECOMMUNICATIONS OY
Keilalahdentie 4
FIN-02150 Espoo
Finland

State of Nationality: FI
State of Residence: FI
Telephone No.:
Facsimile No.:
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [X] the name [ ] the address [ ] the nationality [ ] the residence

Name and Address
NOKIA NETWORKS OY
Keilalahdentie 4
FIN-02150 Espoo
Finland

State of Nationality: FI
State of Residence: FI
Telephone No.:
Facsimile No.:
Teleprinter No.:

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[ ] the International Preliminary Examining Authority
[X] the designated Offices concerned
[ ] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

Authorized officer
R. Chrem
Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

11 -10- 2000

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

PATENTTITOIMISTO TEKNOPOLIS
KOLSTER OY
c/o Kolster OY AB
Iso Roobertinkatu 23
P.O. Box 148
FIN-00121 Helsinki
FINLANDE

Date of mailing (day/month/year)
02 October 2000 (02.10.00)

Applicant's or agent's file reference
T298020PC/su

IMPORTANT NOTIFICATION

International application No.
PCT/FI99/00247

International filing date (day/month/year)
25 March 1999 (25.03.99)

1. The following indications appeared on record concerning:

[X] the applicant [X] the inventor [ ] the agent [ ] the common representative

Name and Address
GUNNARSON, Gudni
Kalevanpuistotie 19 C 111
FIN-33500 Tampere
Finland

State of Nationality: IS
State of Residence: FI
Telephone No.:
Facsimile No.:
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [X] the name [ ] the address [ ] the nationality [ ] the residence

Name and Address
GUNNARSSON, Gudni
Kalevanpuistotie 19 C 111
FIN-33500 Tampere
Finland

State of Nationality: IS
State of Residence: FI
Telephone No.:
Facsimile No.:
Teleprinter No.:

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[X] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer
Maria Victoria CORTIELLO

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 04 January 2000 (04.01.00)	
International application No. PCT/FI99/00247	**Applicant's or agent's file reference** T298020PC/su
International filing date (day/month/year) 25 March 1999 (25.03.99)	**Priority date** (day/month/year) 27 March 1998 (27.03.98)
Applicant RANTALAINEN, Timo, M. et al	

1. The designated Office is hereby notified of its election made:

   [X] in the demand filed with the International Preliminary Examining Authority on:

   25 October 1999 (25.10.99)

   [ ] in a notice effecting later election filed with the International Bureau on:

   _____

2. The election [X] was

   [ ] was not

   made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer R. E. Stoffel
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Form PCT/IB/331 (July 1992)

3034805

PATENTTI- REKISTERIHALLITUS

VÄLIPÄÄTÖS

20.06.2000

Patenttitsto Teknopolis Kolster Oy

Teknologiantie 4

90570 Oulu

Patenttihakemus nro:	980704
Luokka:	H04B 7/26 / JJK
Hakija:	Nokia Networks Oy
Asiamies:	Patenttitsto Teknopolis Kolster Oy
Asiamiehen viite:	T298020FI
Määräpäivä:	20.12.2000

Patenttihakemuksen numero ja luokka on mainittava kirjelmässänne PRH:lle

Tähän mennessä suoritetussa uutuustutkimuksessa on löytynyt seuraavat patentoitavuuden kannalta merkittävinä pidettävät julkaisut: EP-hakemusjulkaisu 740431 (H04B 7/26) ja PCT-hakemusjulkaisu 97/31433 (H04B 7/26), joista julkaisusta tunnetaan esillä olevan patenttihakemuksen vaatimuksien kaltaisia radioviestintäjärjestelmien pääteasemien ja keskus/tukiasemien välisen liikennennöinnin synkronointimenetelmiä-ja järjestelmiä.

Edellä olevan perusteella ei esillä olevan hakemuksen patenttivaatimuksien mukainen keksintö näytä oleellisesti eroavan tunnetusta, joten hakemuksen patenttivaatimuksien mukainen keksintö ei ole hyväksyttävissä (PL 2§).

Tutkijainsinööri Jyrki Karppinen
Puhelin: (09) 6939 5351

Lausumanne huomautusten johdosta on annettava viimeistään yllämainittuna määräpäivänä. Jollette ole antanut lausumaanne virastoon viimeistään mainittuna määräpäivänä tai ryhtynyt toimenpiteisiin tässä välipäätöksessä esitettyjen puutteellisuuksien korjaamiseksi, jätetään hakemus sillensä (patenttilain 15 §). Sillensä jätetty hakemus otetaan uudelleen käsiteltäväksi, jos Te neljän kuukauden kuluessa määräpäivästä annatte lausumanne tai ryhdytte toimenpiteisiin esitettyjen puutteellisuuksien korjaamiseksi ja samassa ajassa suoritatte vahvistetun maksun, 320 mk hakemuksen ottamisesta uudelleen käsiteltäväksi. Jos lausumanne on annettu virastoon oikeassa ajassa, mutta esitettyjä puutteellisuuksia ei ole siten korjattu, että hakemus voitaisiin hyväksyä, se hylätään, mikäli virastolla ei ole aihetta antaa Teille uutta välipäätöstä (patenttilain 16 §). Uusi keksinnön selitys, siihen tehdyt lisäykset ja uudet patenttivaatimukset on aina jätettävä kahtena kappaleena ja tällöin on otettava huomioon patenttiasetuksen 19 §.

PATENTTI- JA REKISTERIHALLITUS **TUTKIMUSRAPORTTI**
Patentti- ja innovaatiolinja

PATENTTIHAKEMUS NRO	LUOKITUS
980704	H04B 7/26

TUTKITTU AINEISTO

Patenttijulkaisukokoelma (FI, SE, NO, DK, DE, CH, EP, WO, GB, US), tutkitut luokat

Tiedonhaut ja muu aineisto

Epoque-hakuja tietokannoista

VIITEJULKAISUT

Kategoria*)	Julkaisun tunnistetiedot	Koskee vaatimuksia
X	EP-A-740431 (H04B 7/26)	1 - 28
X	PCT-A-WO97/31433 (H04B 7/26)	1 - 28

*) X Patentoitavuuden kannalta merkittävä julkaisu yksinään tarkasteltuna
Y Patentoitavuuden kannalta merkittävä julkaisu, kun otetaan huomioon tämä ja yksi tai useampi samaan kategoriaan kuuluva julkaisu
A Yleistä tekniikan tasoa edustava julkaisu, ei kuitenkaan patentoitavuuden este

Päiväys	Tutkija
21.6.2000	Jyrki Karppinen

09/647081

PATENT COOPERATION TREATY

PCT

REC'D 20 JUL 2000

WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference T298020PC/su	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/FI99/00247	International filing date *(day/month/year)* 25.03.1999	Priority date *(day/month/year)* 27.03.1998
International Patent Classification (IPC) or national classification and IPC7 H04J 3/06, H04L 7/00 H04B 7/26		
Applicant NOKIA NETWORKS OY et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
25.10.1999	06.07.2000
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Telex 17978 PATOREG-S Facsimile No. 08-667 72 88	Authorized officer Kristoffer Ogebjer / JA A Telephone No. 08-782 25 00

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/FI99/00247

I. Basis of the report

1. This report has been drawn on the basis of *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

☐ the international application as originally filed.

☒ the description, pages 1-11, as originally filed,
pages _____, filed with the demand,
pages _____, filed with the letter of _____,
pages _____, filed with the letter of _____.

☒ the claims, Nos. _____, as originally filed,
Nos. _____, as amended under Article 19,
Nos. _____, filed with the demand,
Nos. 1-28, filed with the letter of 10.05.2000,
Nos. _____, filed with the letter of _____.

☒ the drawings, ~~sheets~~/fig 1-8, as originally filed,
~~sheets~~/fig _____, filed with the demand
~~sheets~~/fig _____, filed with the letter of _____,
~~sheets~~/fig _____, filed with the letter of _____.

2. The amendments have resulted in the cancellation of:

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, ~~sheets~~/fig _____

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the supplemental Box (Rule 70.2(c)).

4. Additional observations, if necessary:

V. Resoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-28	YES
	Claims		NO
Inventive step (IS)	Claims	1-28	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-28	YES
	Claims		NO

2. Citations and explanations

The claimed invention relates to inter base station synchronisation, transmitting synchronised channels in radio transmitters, where normal radio bursts are transmitted on a normal channel asynchronously.

According to the invention, synchronised timing is obtained, synchronised radio bursts (SB) are formed, and synchronised radio bursts are transmitted in the place of normal radio bursts (NB). The length of the synchronised radio burst (SB) is at most half the length of the normal radio burst (NB). The transmission of the synchronised radio burst (SB) is in synchronisation with the obtained synchronised timing.

Documents cited in the International search report:
[D1] US 5663958, A
[D2] EP 0740431, A1
[D3] GB 2305824, A
[D4] EP 0661836, A1

D1 relates to a method and apparatus for dynamically selecting the length of mobile station burst communications on the reverse digital control channel. The time division multiple access (TDMA) frame time synchronisation error for received mobile station burst communications transmitted on the reserve digital control channel is monitored by the receiving base station. A probability density function is then prepared by the base station reflecting the number of instances of each determined length of time synchronisation error monitored over a predetermined time period. The probability density function

.../...

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V.

is then processed to identify the percentage of burst communications during that predetermined time period that exceed a synchronisation error threshold. If the determined percentage exceeds a given percentage, then abbreviated length burst communication operating mode is ordered by the base station for all mobile stations operating within the cell. Otherwise, conventional length burst communication operating mode is ordered by the base station. The measured time synchronisation error is continuously processed of effectuate dynamic control over the specified length of mobile station burst communications (see abstract; column 4, line 17-column 6, line 35 and claims 1-24).

D2 reveals a method, a central station, a terminal and a network system for time division multiple access (TDMA) management. To allocate time slots to terminal stations for transmission of upstream burst in a network system wherein a central station is coupled to a plurality of terminal stations, the central station downstream transmits access grant information which forms part of downstream frames. Each terminal is equipped with a cyclic local grant counter which generates a local grant counter value between zero and a predetermined limit, and which is synchronised with a cyclic master grant counter included in the central station. The upstream time slots are bounded by two zero crossings of the cyclic local grant counter and a terminal station is allowed to transfer an upstream burst in such a time slot provided that this time slot is allocated to the terminal station via previously received access grant information (column 1, line 3-column 3, line 30 and claims 1-16).

Documents D3 and D4 are state of the art documents that are used to give a better perspective of the claimed invention.

.../...

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V.

The claimed invention according to independent claims 1 and 15 differs from what is disclosed in D1 in the way of using at least two radio transmitters and thereby solving a different problem, inter base station synchronisation, whereas D1 synchronises the transmission between a mobile station and a base station. The invention differs as well in the matter of the length of a normal radio burst and that the normal radio bursts are transmitted on a normal channel asynchronously. Even if it is mentioned in D1 that an abbreviated length burst communication is used with a different burst length, it is not mentioned at which length. Further more, in D2, which is a similar synchronisation system, asynchronous transmission is used.

According to what is stated above the invention according to claims 1-28 is considered to involve an inventive step

CLAIMS 10.5.2000

1. A method of transmitting synchronized channels in at least two radio transmitters, where normal radio bursts are transmitted (606) on a normal channel asynchronously, **characterized** by

(702) obtaining synchronized timing;

(708) forming synchronized radio bursts (SB), the length of which is at most half of the length of a normal radio burst;

(710) transmitting synchronized radio bursts in the place of normal radio bursts such that the transmission of the synchronized radio bursts is synchronized with the obtained synchronized timing.

2. A method according to claim 1, **characterized** by forming at least two successive synchronous radio bursts (SB), at least one of which is transmitted.

3. A method according to claim 1, **characterized** by placing at least one synchronized radio burst (SB) in a burst having the length of a normal radio burst.

4. A method according to claim 3, **characterized** in that the part of the burst that does not belong to the synchronized radio burst (SB) consists of predetermined padding bits (PAD).

5. A method according to claim 1, **characterized** in that the synchronized radio burst (SB) comprises a predetermined bit pattern (TS).

6. A method according to claim 5, **characterized** in that the bit pattern is a training sequence.

7. A method according to claim 1, **characterized** in that the synchronized radio burst (SB) comprises information (INFO), such as the location coordinates (COORD) of the radio transmitted and/or the offset (OFFSET), i.e. the time difference between the transmission moments of the ideal synchronized radio burst and the actual synchronous radio burst.

8. A method according to claim 1, **characterized** by placing the radio burst in a time slot.

9. A method according to claim 1, **characterized** in that the synchronized channel is transmitted by means of at least one normal physical channel.

10. A method according to claim 9, **characterized** by indicating on a control channel the physical channels to be used for the transmission of the synchronized channel.

11. A method according to claim 1, **characterized** in that the physical channels in the direction of reception corresponding to the synchronous channel in the direction of transmission are used to transmit signalling information, such as measurement results.

12. A method according to claim 1, **characterized** in that the method is used in a locating method, such as the OTD (observed time difference) method.

13. A method according to claim 1, **characterized** in that a synchronized radio burst is transmitted when the radio transmitter is in discontinuous transmission.

14. A method according to claim 1, **characterized** in that the transmission of synchronized radio bursts only employs a part of the capacity of a normal channel.

15. A radio transmitter comprising:

a channel codec (216) for forming a normal channel;

a burst former (228) for forming normal radio bursts;

a multiplexer (226) for assigning to each burst the moment for its transmission;

characterized in that

it also comprises a clock (180) for obtaining synchronized timing, which synchronized timing defines the coordination between the transmission of radio bursts from at least two different base stations (100) comprising each at least one radio transmitter;

the channel codec (216) is arranged to form a synchronized channel;

the burst former (228) is arranged to form synchronized radio bursts (SB), the length of which is at most half of the length of a normal radio burst;

the multiplexer (226) is arranged to insert a synchronized radio burst in the place of a normal radio burst such that the transmission of the synchronized radio burst is synchronized with the obtained synchronized timing.

16. A radio transmitter according to claim 15, **characterized** in that the burst former (228) is arranged to form at least two successive synchronous radio bursts (SB) and the multiplexer (226) is arranged to insert at least one of them in the place of a normal radio burst.

17. A radio transmitter according to claim 15, **characterized** in that the burst former (228) is arranged to form a burst the length of which equals the length of a normal radio burst and which comprises at least one synchronized radio burst (SB).

18. A radio transmitter according to claim 17, **characterized** in that the burst former (228) is arranged to place predetermined padding bits (PAD) in the part of the burst that does not belong to the synchronized radio burst (SB).

19. A radio transmitter according to claim 15, **characterized** in that the burst former (228) is arranged to place a predetermined bit pattern (TS) in the synchronized radio burst (SB).

20. A radio transmitter according to claim 19, **characterized** in that the bit pattern is a training sequence.

21. A radio transmitter according to claim 15, **characterized** in that the channel codec (216) is arranged to place in the synchronized radio burst (SB) information, such as the location coordinates (COORD) of the radio transmitter and/or the offset (OFFSET), i.e. the time difference between the transmission moments of the ideal synchronized radio burst and the actual synchronous radio burst.

22. A radio transmitter according to claim 15, **characterized** in that the multiplexer (226) is arranged to place the radio burst in a time slot.

23. A radio transmitter according to claim 15, **characterized** in that the channel codec (216) is arranged to use at least one normal physical channel for the synchronized channel.

24. A radio transmitter according to claim 23, **characterized** in that the radio transmitter is arranged to indicate on a control channel the physical channels to be used for the transmission of the synchronized channel.

25. A radio transmitter according to claim 15, **characterized** in that the radio transmitter is arranged to receive signalling data, such as measurement results, from the channels in the direction of reception corresponding to the synchronous channels in the direction of transmission.

26. A radio transmitter according to claim 15, **characterized** in that the clock (180) is a GPS receiver.

27. A radio transmitter according to claim 15, **characterized** in that the radio transmitter is arranged to transmit a synchronized radio burst when the transmitter is in discontinuous transmission.

28. A radio transmitter according to claim 15, **characterized** in that the radio transmitter is arranged to use only a part of the capacity of a normal channel for the transmission of synchronized radio bursts.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04J 3/06 | A2

(11) International Publication Number: **WO 99/53640**

(43) International Publication Date: 21 October 1999 (21.10.99)

(21) International Application Number: PCT/FI99/00247

(22) International Filing Date: 25 March 1999 (25.03.99)

(30) Priority Data:
980704 27 March 1998 (27.03.98) FI

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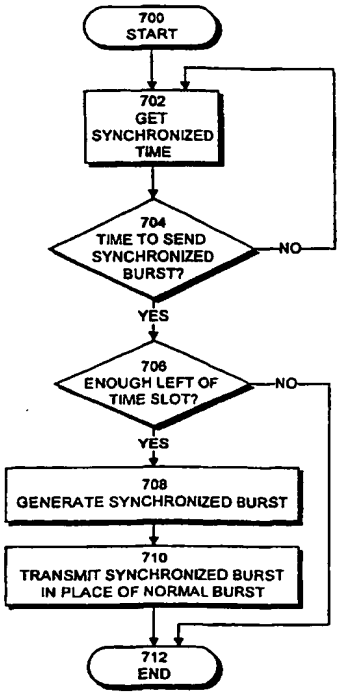
(54) Title: METHOD OF TRANSMITTING SYNCHRONIZED CHANNEL IN RADIO TRANSMITTER

(57) Abstract

The invention relates to a method of transmitting a synchronized channel in a radio transmitter and to a radio transmitter. The method comprises transmitting (606) normal radio bursts on a normal channel asynchronously. In the invention, synchronized timing is obtained (702), synchronized radio bursts (SB) are formed (708), and a synchronized radio burst is transmitted (710) in the place of a normal radio burst (NB). The length of the synchronized radio burst (SB) is at most half of the length of the normal radio burst (NB). The transmission of the synchronized radio burst (SB) is in synchronization with the obtained synchronized timing.



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METHOD OF TRANSMITTING SYNCHRONIZED CHANNEL IN RADIO TRANSMITTER

FIELD OF THE INVENTION

The invention relates to a method of transmitting a synchronized channel in a radio transmitter, where normal radio bursts are transmitted on a normal channel asynchronously.

BACKGROUND OF THE INVENTION

Cellular radio networks comprise applications which require that a subscriber terminal or some other corresponding radio receiver receives synchronized radio signals from various base stations. Such applications include different methods of locating subscriber terminals. An example of such locating methods is an OTD (Observed Time Difference) method based on time differences detected in the reception of signals. In this method a terminal equipment measures differences in times of arrivals of signals transmitted by base stations. The method requires that the base stations transmit signals at the same moment, in other words synchronously, or otherwise data is required on the differences in synchronization (Real Time Difference, RTD) between the base stations if the base stations are not synchronized. The location is carried out based on this data. This method is described in greater detail in Finnish Patent Application 954,705.

Several systems, such as the GSM system, are not synchronized or they are not synchronized sufficiently accurately so that the signals could be used in the location according to the OTD method. In the GSM system, normal channels are divided both on a time division (TDMA, time division multiple access) and frequency division (FDMA, frequency division multiple access) basis. A radio transmitter thus uses a specific time slot on a predetermined frequency for transmitting a normal physical channel. In the GSM system, the base stations transmit radio bursts of a normal channel asynchronously, which means that the transmissions between the base stations are not coordinated such that each base station would transmit a radio burst simultaneously. Further, the aforementioned synchronization differences between the base stations change over time. Therefore the OTD method cannot be used for location without continuous measurement of the synchronization differences. Measurement of the synchronization differences produces more signalling and causes additional error in the accuracy of the location.

One suggested solution is to synchronize all the radio transmitters with each other by means of a satellite-based locating system (global positioning system, GPS), in which case a GPS receiver would be installed at each base station. This arrangement may cause problems in the GSM system since the system utilizes hierarchical clocks. This means that a base station controller guiding a base station obtains timing from higher network elements and delivers it to the base stations. If a GPS receiver were used for the timing of the base station transmission, the entire timing of the GSM system would be confused.

BRIEF DESCRIPTION OF THE INVENTION

An object of the invention is to develop a method and an apparatus implementing the method which solve the aforementioned problems. This is achieved with a method of the type described in the introduction, which is characterized by obtaining synchronized timing; forming synchronized radio bursts, the length of which is at most half of the length of a normal radio burst; transmitting a synchronized radio burst in the place of a normal radio burst such that the transmission of the synchronized radio burst is synchronized with the obtained synchronized timing.

The invention also relates to a radio transmitter comprising a channel codec for forming a normal channel; a burst former for forming normal radio bursts; a multiplexer for assigning to each burst the moment for its transmission.

The radio transmitter according to the invention is characterized in that it also comprises a clock for obtaining synchronized timing; the channel codec is arranged to form a synchronized channel; the burst former is arranged to form synchronized radio bursts, the length of which is at most half of the length of a normal radio burst; the multiplexer is arranged to insert a synchronized radio burst in the place of a normal radio burst such that the transmission of the synchronized radio burst is synchronized with the obtained synchronized timing.

The preferred embodiments of the invention are disclosed in the dependent claims.

A basic idea of the invention is that a radio burst normally used by a radio transmitter is at least halved so that the obtained synchronized radio burst can always be inserted flexibly in the place of the normal radio burst. The expression 'in the place of' means that the normal radio burst is replaced in

principle, i.e. the burst that is to be actually transmitted is not necessarily replaced but the synchronized burst is transmitted during the time slot in which it would be possible in principle to transmit the normal radio burst.

The method and the radio transmitter according to the invention provide several advantages. Synchronized signals can be transmitted to a receiver without a need to make any changes in the general timing structure. For example the GSM system does not require changes in the TDMA frame structure. The structure of the synchronized signals can be optimized according to the needs of the intended use, such as a locating method.

BRIEF DESCRIPTION OF THE FIGURES

In the following the invention will be described in greater detail in connection with preferred embodiments, with reference to the accompanying drawings, in which

Figure 1 shows an example of the structure of a cellular radio network employing the invention,

Figure 2 shows the structure of a transceiver,

Figure 3 shows synchronized radio bursts according to the invention and the moments when they are transmitted at four different base stations,

Figure 4 shows two different alternatives of transmitting a synchronized radio burst in the place of a normal radio burst,

Figure 5 shows the structure of a synchronized radio burst,

Figures 6 and 7 are flowcharts illustrating the implementation of the method according to the invention,

Figure 8 shows the positioning of a synchronized radio burst with padding bits in the place of a normal radio burst.

DETAILED DESCRIPTION OF THE INVENTION

The invention can be used in different radio transmitters. The examples describe the use of the invention in a cellular radio network. With reference to Figure 1, the structure of a typical cellular radio network will be described. Figure 1 only contains the blocks that are essential for explaining the invention, but it is clear for those skilled in the art that a conventional cellular radio network also comprises other functions and structures, which do not have to be described in greater detail herein. The examples describe a

cellular radio network employing time division multiple access (TDMA) without restricting the invention thereto, however.

A cellular radio network typically comprises a fixed network infrastructure, i.e. a network part 128, and subscriber terminals 150, which may be fixed, located in a vehicle or portable hand-held terminal equipments. The network part 128 comprises base stations 100. Several base stations 100 are controlled in a centralized manner by a base station controller 102 communicating with them. A base station 100 comprises transceivers 114. A base station 100 typically comprises 1 to 16 transceivers 114. For example in the TDMA radio system, one transceiver 114 typically provides radio capacity for one TDMA frame, i.e. eight time slots.

The base station 100 comprises a control unit 118, which controls the operation of the transceivers 114 and a multiplexer 116. The multiplexer 116 places the traffic and control channels used by several transceivers 114 onto a single transmission link 160.

The transceivers 114 of the base station 100 have a connection to an antenna unit 112, which realizes a bidirectional radio link 170 to a subscriber terminal 150. The structure of frames to be transmitted on the bidirectional radio link 170 is accurately determined and it is referred to as an air interface.

Figure 2 shows in greater detail the structure of a transceiver 114. The functions at the reception will be described first. A receiver 200 comprises a filter blocking frequencies outside a desired frequency band. A signal is thereafter converted onto an intermediate frequency or directly to baseband, and the signal in this form is sampled and quantized in an A/D converter 202.

An equalizer 204 compensates for interference caused by multipath propagation, for example. A demodulator 206 extracts from the equalized signal a bit stream, which is transferred to a demultiplexer 208. The demultiplexer 208 separates the desired part from the received bit stream into logical channels. This function is based on the structure of the received bit stream, which consists of radio bursts placed in time slots, forming a physical channel.

A channel codec 216 decodes bit streams of different logical channels, i.e. it decides whether a bit stream consists of signalling data, which is transmitted to a control unit 214, or speech, which is transmitted 240 to a speech codec 122 in the base station controller 102. The channel codec 216

decodes possible channel coding, such as block coding and convolutional coding, deinterleaves possible interleaving, and decrypts the encryption used over the radio path.

The control unit 214 carries out internal control tasks by controlling different units mainly on the basis of control received from the base station controller 102.

The functions at the transmission will be described next. The data to be transmitted is channel-coded, interleaved and encrypted in the channel codec 216. A burst former 228 adds a training sequence and a tail to the data arriving from the channel codec 216. A multiplexer 226 assigns to each burst its physical channel. A modulator 224 modulates digital signals onto a radio frequency carrier. This function is analogous, wherefore it requires a D/A converter 222.

A transmitter 220 comprises a filter restricting the bandwidth. The transmitter 220 also controls the output power of the transmission. A synthesizer 212 provides different units with required frequencies. The synthesizer 212 comprises a clock, which may be locally controlled or controlled in a centralized manner from some other place, for example the base station controller 102. The synthesizer 212 creates the necessary frequencies by means of a voltage-controlled oscillator, for example.

As shown in Figure 2, the structure of the transceiver can further be divided into radio-frequency parts 230 and a digital signal processor with its software 232. The radio-frequency parts 230 comprise the receiver 200, the transmitter 220 and the synthesizer 212. The digital signal processor with its software 232 comprises the equalizer 204, the demodulator 206, the demultiplexer 208, the channel codec 216, the control unit 214, the burst former 228, the multiplexer 226 and the modulator 224. Conversion of an analogue radio signal into a digital signal requires an A/D converter 202 and, correspondingly, the conversion of a digital signal into an analogue signal requires a D/A converter 222.

The base station controller 102 comprises a group switching field 120 and a control unit 124. The group switching field 120 is used for switching speech and data and for connecting signalling circuits. The base station 100 and the base station controller 102 form a base station system 126, which also comprises a transcoder 122. The distribution of functions between the base station controller 102 and the base station 100 as well as their physical

structure may vary in different implementations. The base station 100 typically manages the implementation of the radio path as described above. The base station controller 102 typically manages the following things: configuration of traffic channels, frequency hopping control, paging of subscriber terminals, power control, quality control of active channels, and handover control.

The transcoder 122 is usually located as close to a mobile services switching centre 132 as possible, because this allows speech to be transmitted between the transcoder 122 and the base station controller 102 in a cellular radio network form, which saves transmission capacity. The transcoder 122 converts different digital speech coding modes used between a public switched telephone network and a radio phone network to make them compatible, for example from a 64 kbit/s fixed network form to another form (such as 13 kbit/s) of the cellular radio network, and vice versa. The control unit 124 performs call control, mobility management, gathering of statistical data, and signalling.

As shown in Figure 1, a circuit-switched connection can be set up from the subscriber terminal 150 to a telephone 136 connected to the public switched telephone network (PSTN) 134 via the mobile services switching centre 132. The cellular radio network may also employ a packet-switched connection, for example 2+ phase packet transmission, i.e. GPRS (General Packet Radio Service), of the GSM system.

The structure of the subscriber terminal 150 can be described by means of the representation of the structure of the transceiver 114 shown in Figure 2. The structural elements of the subscriber terminal 150 are functionally identical to those of the transceiver 114. The subscriber terminal 150 also comprises a duplex filter between the antenna 112 and the receiver 200 and the antenna and the transmitter 220, user interface parts and a speech codec. The speech codec is connected to the channel codec 216 via a bus 240.

Figure 3 shows how transmissions of four different base stations BTS 1, BTS 2, BTS 3, BTS 4 are not synchronized with each other. Each base station transmits its normal bursts NB at instants that differ randomly from one another. According to the invention, each base station receives timing, which is described in Figure 3 by successive bursts SYNCHRONIZED BURSTS. Timing is received from a clock, which is for example a GPS receiver 180

connected to the control unit 118 of the base station 100 as shown in Figure 1. The control unit 118 forwards the received timing to the transceivers 114.

In the invention, a special synchronous channel is formed in the channel codec 216. In principle the synchronous channel is placed on a normal physical channel. The number of physical channels available is a compromise. For example in the OTD locating method, the more frequently synchronous signals are transmitted the more often the subscriber terminal 150 is able to receive them and to carry out more measurements, which improves the accuracy of the location. On the other hand, this consumes more traffic capacity of the system. The example shown in Figure 3 utilizes one frequency, i.e. all the eight time slots of one TDMA frame, i.e. eight physical traffic channels. If the traffic capacity is to be consumed as little as possible, only one time slot can be used to transmit synchronized bursts, for example time slot 'one' of a broadcast control channel (BCCH), in which case the subscriber terminal 150 always knows the location of the synchronized bursts after it has received one normal synchronization channel burst (SCH). In order that the capacity of an uplink physical channel corresponding to a downlink synchronized channel would not be wasted, the capacity can be used to forward signalling data, such as measurement results of the subscriber terminal 150, to the base station 100.

A preferred embodiment utilizes the normally unused capacity for transmission of synchronized radio bursts. For example when a radio transmitter is in a mode of discontinuous transmission (DTX) and no normal radio bursts are being transmitted, it is possible to transmit instead synchronized radio bursts, on the basis of which the subsicber terminal 150 is able to determine its location, for example.

Another method of making the operation more effective is to transmit synchronized radio bursts by means of only a part of the capacity of a physical channel. In such a situation the synchronous bursts are repeated according to a predetermined sequence, for example in every third time slot of the physical channel.

The physical channel to be used for transmitting the synchronized channel can be indicated to the subscriber terminal 150 on a control channel, such as the broadcast control channel (BCCH).

The burst former 228 is arranged to form synchronized radio bursts SB. The length of a synchronized radio burst SB is at most half of the

length of a normal burst NB in order that the synchronized burst SB can always be inserted in the place of the normal burst NB. The multiplexer 226 is arranged to insert the synchronized radio burst SB in the place of the normal radio burst NB in such a way that the transmission of the synchronized burst SB is synchronized with the timing obtained from the clock 180.

Figure 3 shows timing in the form of possible synchronized bursts SYNCHRONIZED BURSTS. A vertical line has been drawn from the start and end of each such burst to describe the instant a synchronous burst SB can be transmitted at each base station BTS 1 TIMING, BTS 2 TIMING, BTS 3 TIMING, BTS 4 TIMING. The synchronized bursts SB transmitted by each base station start and end at exactly the same instant.

It can be seen from Figure 3 that in a preferred embodiment the timings happen to match at base station BTS 1, whereupon two synchronized bursts SB can be transmitted in the place of a normal burst NB. The burst former 228 is arranged to form successive synchronized bursts SB, which the multiplexer 226 inserts in the place of the normal burst NB since they fit there. On the other hand, this embodiment can also be avoided if receiving two synchronized bursts during one time slot causes problems in the subscriber terminal 150, in which case only one of the synchronized bursts is transmitted.

At base station BTS 2, the timings differ from one another exactly half a time slot, and therefore it is possible to transmit two synchronized bursts SB in the place of the normal burst NB.

However, in the most common situation the timing obtained by the base station 100 from the network and the timing obtained from the clock 180 do not match. In such a case it is possible to transmit only one synchronized burst SB in the place of the normal burst NB as shown in Figure 3 with base stations BTS 3 and BTS 4. As the figure shows, every other synchronous burst SB would extend to two normal bursts NB, which is not desirable.

Figure 5 illustrates the structure of a synchronized burst SB. In the same way as a normal burst a synchronized burst must also comprise tail bits TB both at the beginning and end of the burst. These bits are used during a guard period when the transmitter increases the power to the required transmit power and thereafter lowers it to the idle state. The tail bits are usually set to zero.

As shown in Figure 4, a synchronized burst SB can be inserted in the place of a normal burst NB in two different manners. The first manner is

shown in the middle in the figure. The synchronized burst SB shown therein is a special burst of Figure 5, the length of which is at most half of the normal burst NB. Nothing else is transmitted in this time slot besides the synchronized burst SB.

The second manner is illustrated in Figure 4 at the bottom. The burst former 228 is arranged to form a burst that is equal in length to a normal radio burst NB, and a synchronized burst SB is inserted therein. The part of the formed burst that does not belong to the synchronized burst SB is filled with predetermined padding bits PAD. This embodiment provides an advantage that the transmission time of the burst does not have to be changed, but only the content thereof is altered.

As shown in Figure 5, the synchronized burst SB comprises at least a predetermined bit pattern TS. Usually this bit pattern is a training sequence which is also known to the receiver and which can be searched in the equalizer 204. By comparing this known training sequence to the signal that is actually received it is possible to estimate what kind of distortions have accumulated in the signal over the radio path. When the receiver receives the synchronized burst SB it also obtains accurate timing, since the transmission moment of the burst is determined to be the same at different base stations, unlike in the case of normal bursts NB. For the purpose of locating methods the structure of a known bit pattern can be optimized suitably.

In a preferred embodiment a synchronized burst also comprises other information INFO as shown in Figure 5. The information may contain the location coordinates COORD of the base station 100. Timing offset OFFSET can also be transmitted in the information field INFO. In this case the offset refers to the time difference between the transmission moments of the ideal synchronized radio burst and the actual synchronized radio burst. In reality, the transmission moment of the synchronized burst SB can be adjusted with the accuracy of maybe only one bit or one fourth of a bit, in which case the offset indicates the difference from the exact correct transmission moment. The information may further include other information OTHER INFO, and the information can also be combined COORD + OFFSET in a desired manner.

To obtain the most accurate possible timing the training sequence TS should be as long as possible. Therefore some or even all of the information INFO can be transferred to padding bits PAD, so that the training sequence TS can be continued to the place of the information INFO. Since the

position of the synchronized burst SB varies, sometimes the information INFO would be placed before and sometimes after the synchronized burst SB. In such a case the subscriber terminal 150 must be able to select the correct place from which the information INFO is decoded.

Figure 8 shows how a synchronized radio burst SB is inserted with padding bits PAD in the place of a normal radio burst NB. This figure illustrates the implementation of the alternative shown lowermost in Figure 4. The tail bits TB are naturally situated at the beginning and end of the burst. They are followed by padding bits PAD, which surround the training sequence TS and the information INFO.

The invention is preferably implemented by means of software and it requires changes in an accurately restricted area of the software of the digital signal processor 232 in the transceiver 114 of the base station 100. The invention further requires that a radio transmitter obtains synchronized timing for example from the clock 180.

The implementation of the method according to the invention in a radio transmitter is further illustrated with reference to the flowcharts of Figures 6 and 7. The method starts in block 600. In block 602 the method proceeds to the next time slot. In block 604 it is checked whether the logical channel to be transmitted in the time slot is normal or synchronized. In block 606 normal radio bursts are transmitted asynchronously on a normal channel. In block 608, a synchronized burst formed according to the invention is transmitted. In block 610 it is checked whether the method is to be continued. If not, the execution of the method is terminated in block 612. If it is continued, the process proceeds to block 602, where the processing of the next time slot is started.

Block 608 is described in greater detail in Figure 7. The implementation begins in block 700. Synchronized timing is obtained in block 702. Next, it is checked in block 704 whether it is time to transmit a synchronized burst. If not, the process moves back to block 702 where the clock is checked. This is repeated until it is time to transmit the synchronized burst. When it is detected after the checking carried out in block 704 that it is time to transmit a synchronized burst, the method proceeds to block 706. In block 706 it is checked whether a sufficient part of the time slot is left for the transmission of the synchronized burst. If not, the method proceeds to block 712. If a sufficient part of the time slot is left, the process moves to block 708

where synchronized radio bursts SB are formed, the bursts having a length of at most half of the length of a normal radio burst. Next, in block 710 the synchronized radio burst is transmitted in the place of a normal radio burst such that the transmission of the synchronized burst is synchronized with the obtained synchronized timing. The last step is block 712 where the execution of block 608 is terminated.

Even though the invention is described above with reference to the example according to the accompanying drawings, it is clear that the invention is not restricted thereto but it can be modified in several ways within the scope of the inventive idea disclosed in the appended claims.

CLAIMS

1. A method of transmitting a synchronized channel in a radio transmitter, where normal radio bursts are transmitted (606) on a normal channel asynchronously, **characterized** by

(702) obtaining synchronized timing;

(708) forming synchronized radio bursts (SB), the length of which is at most half of the length of a normal radio burst;

(710) transmitting a synchronized radio burst in the place of a normal radio burst such that the transmission of the synchronized radio burst is synchronized with the obtained synchronized timing.

2. A method according to claim 1, **characterized** by forming at least two successive synchronous radio bursts (SB), at least one of which is transmitted.

3. A method according to claim 1, **characterized** by placing at least one synchronized radio burst (SB) in a burst having the length of a normal radio burst.

4. A method according to claim 3, **characterized** in that the part of the burst that does not belong to the synchronized radio burst (SB) consists of predetermined padding bits (PAD).

5. A method according to claim 1, **characterized** in that the synchronized radio burst (SB) comprises a predetermined bit pattern (TS).

6. A method according to claim 5, **characterized** in that the bit pattern is a training sequence.

7. A method according to claim 1, **characterized** in that the synchronized radio burst (SB) comprises information (INFO), such as the location coordinates (COORD) of the radio transmitted and/or the offset (OFFSET), i.e. the time difference between the transmission moments of the ideal synchronized radio burst and the actual synchronous radio burst.

8. A method according to claim 1, **characterized** by placing the radio burst in a time slot.

9. A method according to claim 1, **characterized** in that the synchronized channel is transmitted by means of at least one normal physical channel.

10. A method according to claim 9, **characterized** by indicating on a control channel the physical channels to be used for the transmission of the synchronized channel.

11. A method according to claim 1, **characterized** in that the physical channels in the direction of reception corresponding to the synchronous channel in the direction of transmission are used to transmit signalling information, such as measurement results.

12. A method according to claim 1, **characterized** in that the method is used in a locating method, such as the OTD (observed time difference) method.

13. A method according to claim 1, **characterized** in that a synchronized radio burst is transmitted when the radio transmitter is in discontinuous transmission.

14. A method according to claim 1, **characterized** in that the transmission of synchronized radio bursts only employs a part of the capacity of a normal channel.

15. A radio transmitter comprising:

a channel codec (216) for forming a normal channel;

a burst former (228) for forming normal radio bursts;

a multiplexer (226) for assigning to each burst the moment for its transmission;

characterized in that

it also comprises a clock (180) for obtaining synchronized timing;

the channel codec (216) is arranged to form a synchronized channel;

the burst former (228) is arranged to form synchronized radio bursts (SB), the length of which is at most half of the length of a normal radio burst;

the multiplexer (226) is arranged to insert a synchronized radio burst in the place of a normal radio burst such that the transmission of the synchronized radio burst is synchronized with the obtained synchronized timing.

16. A radio transmitter according to claim 15, **characterized** in that the burst former (228) is arranged to form at least two successive synchronous radio bursts (SB) and the multiplexer (226) is arranged to insert at least one of them in the place of a normal radio burst.

17. A radio transmitter according to claim 15, **characterized** in that the burst former (228) is arranged to form a burst the length of

which equals the length of a normal radio burst and which comprises at least one synchronized radio burst (SB).

18. A radio transmitter according to claim 17, **characterized** in that the burst former (228) is arranged to place predetermined padding bits (PAD) in the part of the burst that does not belong to the synchronized radio burst (SB).

19. A radio transmitter according to claim 15, **characterized** in that the burst former (228) is arranged to place a predetermined bit pattern (TS) in the synchronized radio burst (SB).

20. A radio transmitter according to claim 19, **characterized** in that the bit pattern is a training sequence.

21. A radio transmitter according to claim 15, **characterized** in that the channel codec (216) is arranged to place in the synchronized radio burst (SB) information, such as the location coordinates (COORD) of the radio transmitter and/or the offset (OFFSET), i.e. the time difference between the transmission moments of the ideal synchronized radio burst and the actual synchronous radio burst.

22. A radio transmitter according to claim 15, **characterized** in that the multiplexer (226) is arranged to place the radio burst in a time slot.

23. A radio transmitter according to claim 15, **characterized** in that the channel codec (216) is arranged to use at least one normal physical channel for the synchronized channel.

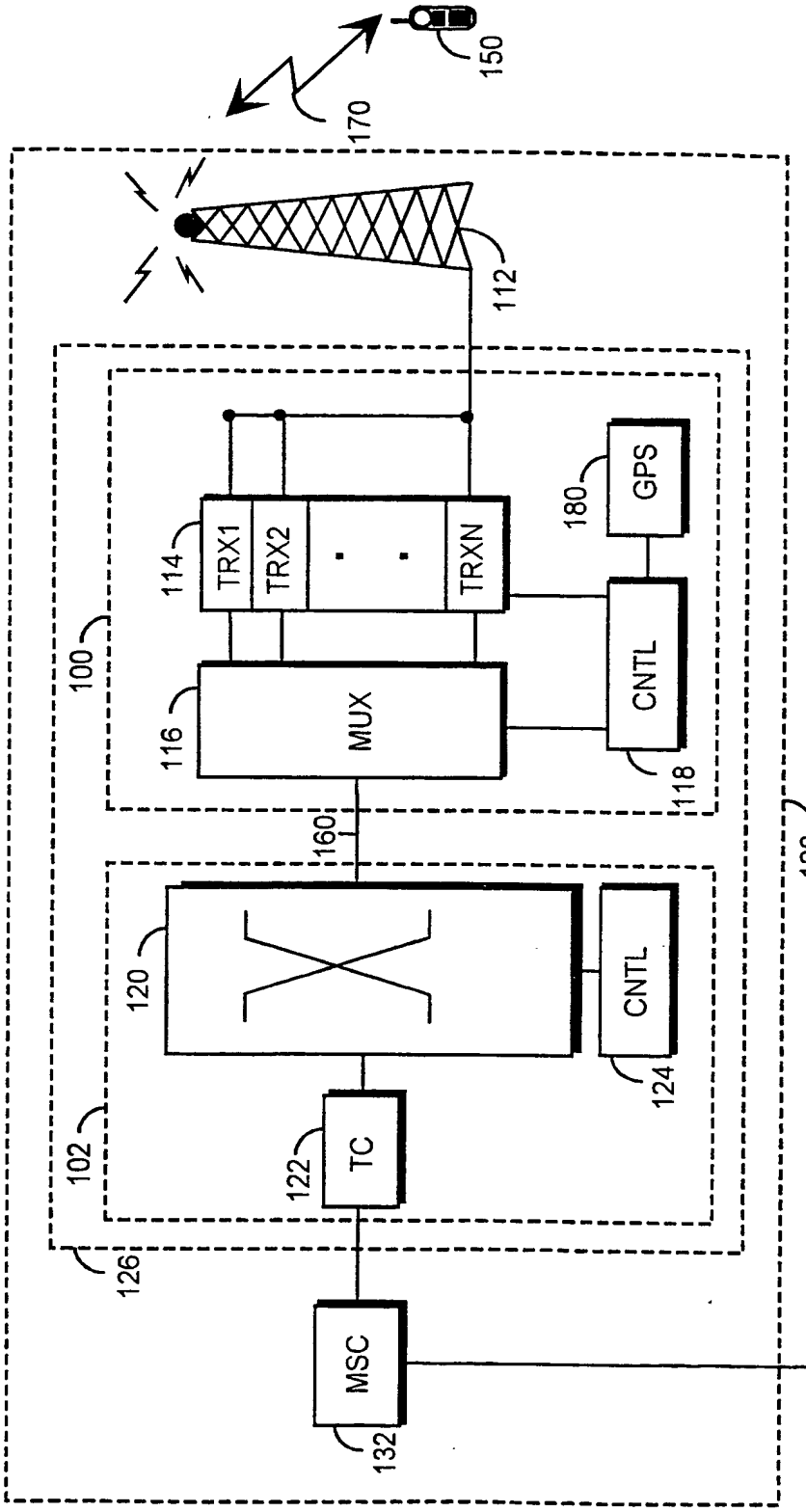
24. A radio transmitter according to claim 23, **characterized** in that the radio transmitter is arranged to indicate on a control channel the physical channels to be used for the transmission of the synchronized channel.

25. A radio transmitter according to claim 15, **characterized** in that the radio transmitter is arranged to receive signalling data, such as measurement results, from the channels in the direction of reception corresponding to the synchronous channels in the direction of transmission.

26. A radio transmitter according to claim 15, **characterized** in that the clock (180) is a GPS receiver.

27. A radio transmitter according to claim 15, **characterized** in that the radio transmitter is arranged to transmit a synchronized radio burst when the transmitter is in discontinuous transmission.

28. A radio transmitter according to claim 15, **characterized** in that the radio transmitter is arranged to use only a part of the capacity of a normal channel for the transmission of synchronized radio bursts.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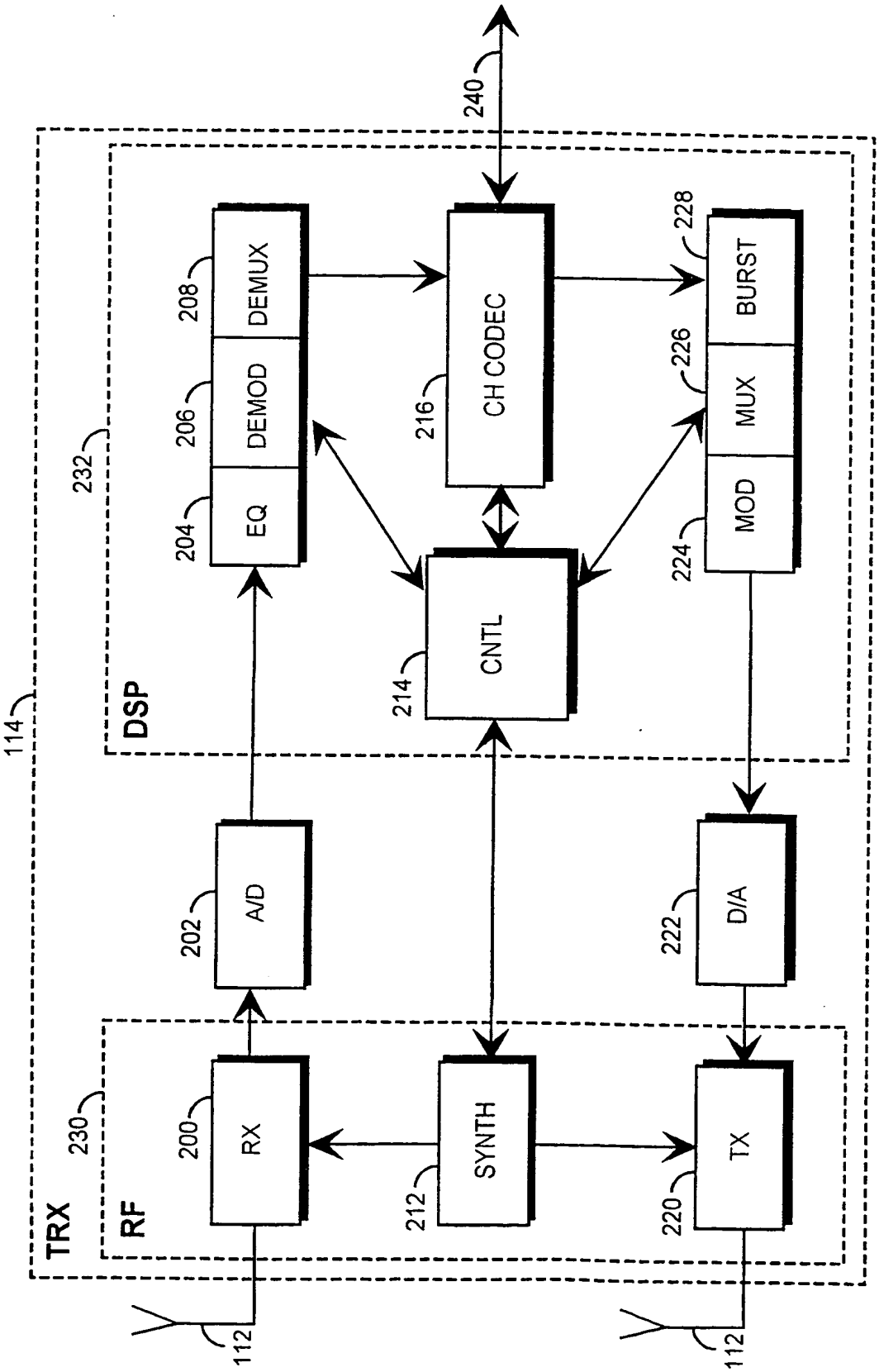
CNTL
124
102
122
TC
126
136
MSC
132
PSTN
134

Fig 1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DEMUX
206
DEMOD
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EQ
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CH CODEC
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CNTL
228
BURST
226
MUX
224
MOD
202
A/D
222
D/A
TRX
230
RF
200
RX
212
SYNTH
220
TX
112
112

Fig 2

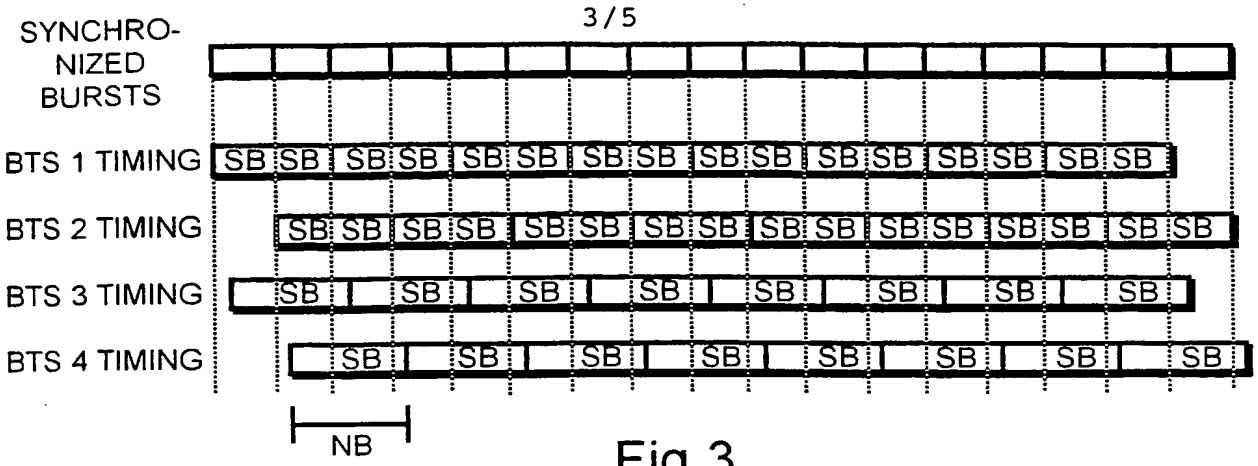


Fig 3

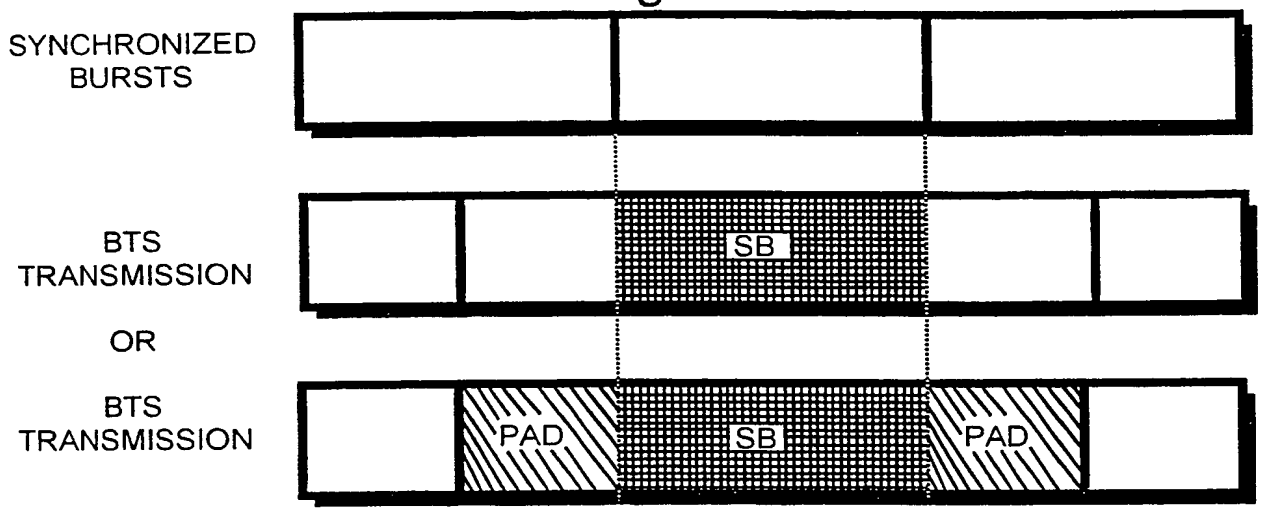


Fig 4

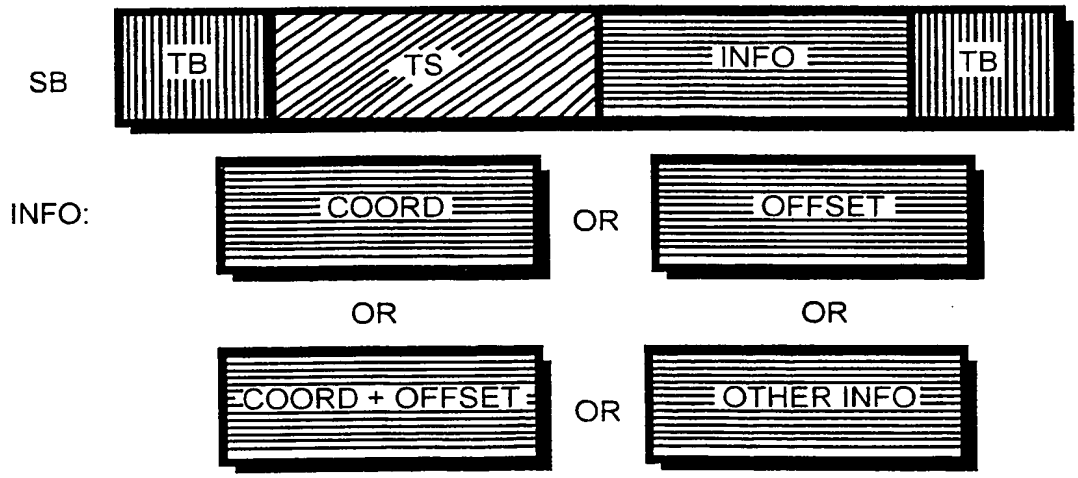


Fig 5

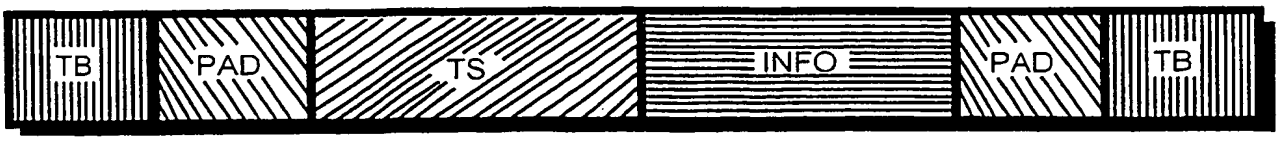
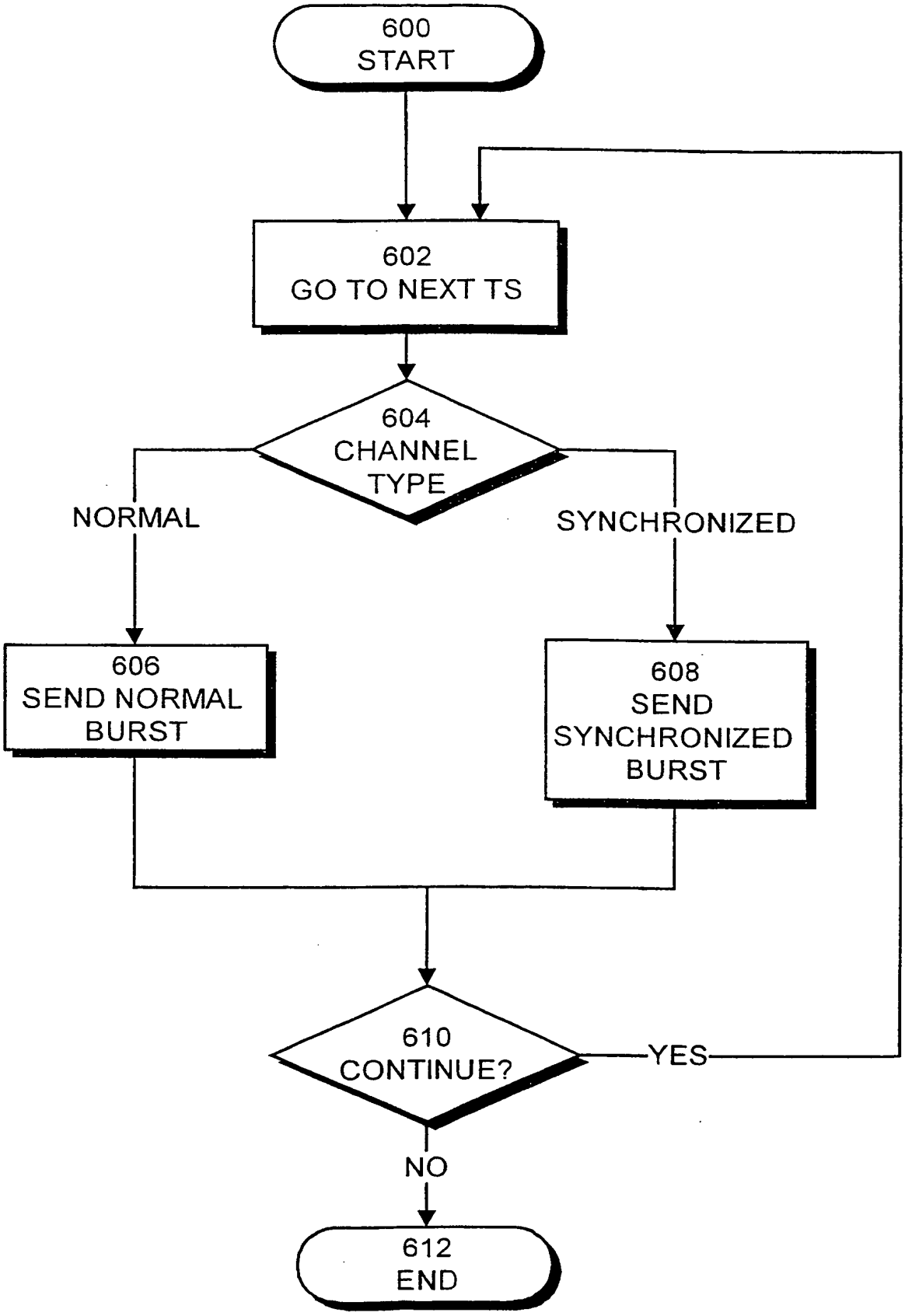


Fig 8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START
602
GO TO NEXT TS
604
CHANNEL
TYPE
NORMAL
SYNCHRONIZED
606
SEND NORMAL
BURST
608
SEND
SYNCHRONIZED
BURST
610
CONTINUE?
YES
NO
612
END

Fig 6

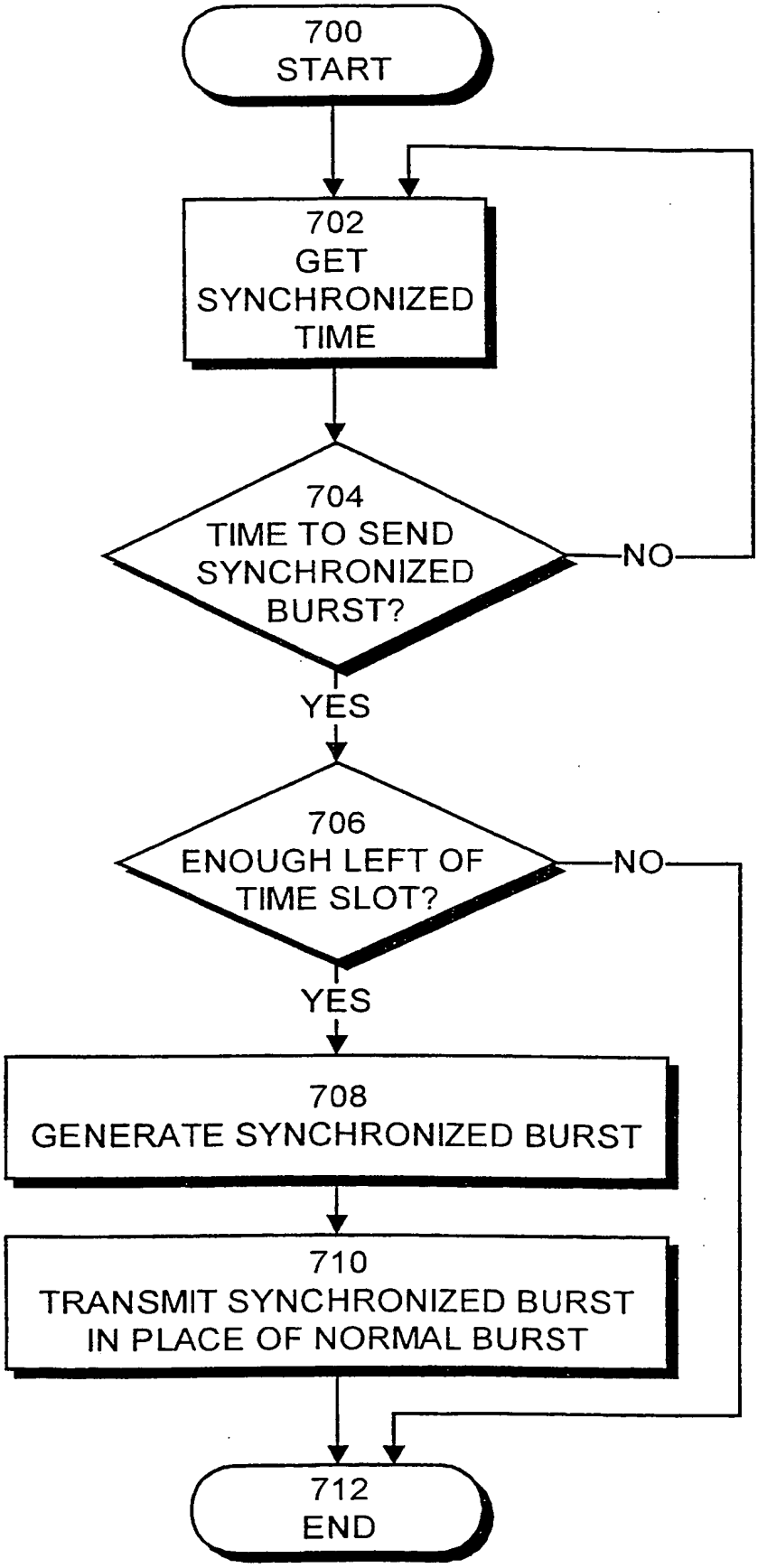
700
START
702
GET
SYNCHRONIZED
TIME
704
TIME TO SEND
SYNCHRONIZED
BURST?
NO
YES
706
ENOUGH LEFT OF
TIME SLOT?
NO
YES
708
GENERATE SYNCHRONIZED BURST
710
TRANSMIT SYNCHRONIZED BURST
IN PLACE OF NORMAL BURST
712
END

Fig 7

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H04J 3/06, H04L 7/00, H04B 7/26

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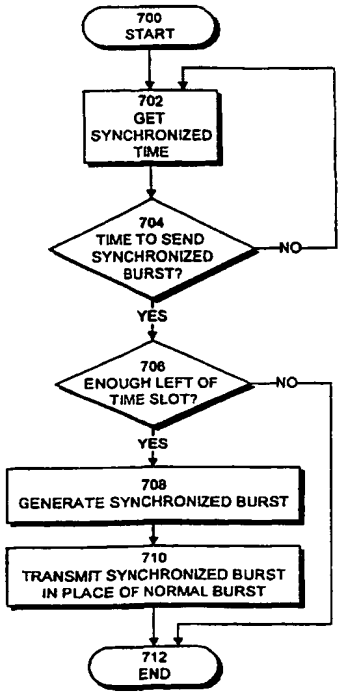
(57) Abstract

The invention relates to a method of transmitting a synchronized channel in a radio transmitter and to a radio transmitter. The method comprises transmitting (606) normal radio bursts on a normal channel asynchronously. In the invention, synchronized timing is obtained (702), synchronized radio bursts (SB) are formed (708), and a synchronized radio burst is transmitted (710) in the place of a normal radio burst (NB). The length of the synchronized radio burst (SB) is at most half of the length of the normal radio burst (NB). The transmission of the synchronized radio burst (SB) is in synchronization with the obtained synchronized timing.



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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 99/00247

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04J 3/06, H04L 7/00, H04B 7/26
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5663958 A (TORBJORN WARD), 2 Sept 1997 (02.09.97), column 4, line 17 - column 6, line 35, claims 1-24, abstract --	1-28
Y	EP 0740431 A1 (ALCATEL BELL), 30 October 1996 (30.10.96), column 1, line 3 - column 3, line 30, claims 1-16 --	1-28
A	GB 2305824 A (MATSUSHITA ELECTRIC INDUSTRIAL CO. LTD.), 16 April 1997 (16.04.97), page 1, line 5 - page 6, line 11, abstract --	1-28

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Date of the actual completion of the international search	Date of mailing of the international search report
11 October 1999	13 -10- 1999
Name and mailing address of the ISA Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Roger Boufaisal/mj Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 99/00247

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A	EP 0661836 A1 (ALCATEL STANDARD ELECTRICA), 5 July 1995 (05.07.95), see the whole document -- --------	1-28

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Information on patent family members

28/09/99

International application No.
PCT/FI 99/00247

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